SUGARBEET RESEARCH

1973 REPORT

A Report to and for
the Sole Use of Cooperators

NOT FOR PUBLICATION

F O R E W O R D

SUGARBEET RESEARCH is an annual compilation of progress reports concerning incomplete research by Agricultural Research Service investigators and cooperators who are engaged in sugarbeet variety and production research. The report has been assembled by Dr. John S. McFarlane, Technical Advisor for sugarbeet variety and production research in the Western Region of the Agricultural Research Service. The report has been reproduced at the expense of the Beet Sugar Development Foundation, and is for the sole use of the cooperators. Much of the data has not been sufficiently confirmed to justify general release and interpretations may be modified with additional experimentation. The report is not intended for publication and should not be used for cited reference nor quoted in publicity or advertising. Reproduction of any portion of the material contained herein will not be permitted without the specific consent of the contributor or contributors.

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Trade names occur in this report solely to provide specific information and do not signify endorsement by the U.S. Department of Agriculture or the Beet Sugar Development Foundation.

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SUGARBEET RESEARCH

1973 Report

Section A

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Cooperation:

American Crystal Sugar Company
Holly Sugar Corporation
Spreckels Sugar Division
Union Sugar Division
California Beet Growers Association

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SUMMARY OF ACCOMPLISHMENTS, 1973

YELLOWS RESISTANCE--The results of the yellows and yield performance tests for 1973 at Salinas (Tests 673, 773, 873, 1073) were disappointing. Most of these tests had relatively poor performance. This poor performance was apparently due in part to the late date of planting (April). One of the most important accomplishments of 1973 was determining that variety trials at Salinas need to be planted early (January or February) to obtain good data on varietal and yellows infection differences. A large number of inbred and self-fertile lines and composites were evaluated for yellows resistance (Test 1273). The results of this test suggested that we still do not have inbred or self-fertile lines with good yellows resistance. This may partially be due to a negative correlation between the yield of lines and their apparent resistance as measured by percent loss data. In an attempt to develop inbred lines with additional yellows resistance, 36 self-fertile, monogerm lines were mass selected from BYV-BWYV infected spaced plantings. Nine open-pollinated populations were also selected for yellows resistance. The development of breeding methods and techniques particular to the yellows resistance program and Salinas conditions were continued. It was found that adequate quantities of testcross seed from individual plants could be obtained to permit progeny testing in the field. It is hoped that various schemes of testcrossing and progeny testing will increase the precision of selecting for yellows resistance in combination with yield and sucrose combining ability, particularly within self-fertile populations. The development of source populations for these breeding schemes was continued. In general, broadbase populations combining as many desirable traits as possible, e.g., curly top resistance, bolting resistance, monogerm seed, O-types, etc., are being bred. R. T. Lewellen, I. O. Skoyen, J. S. McFarlane.

VULGARIS-PROCUMBENS HYBRIDS--Plants were irradiated with doses ranging from 500 to 3000 rentgen at various stages before anthesis. Dr. Savitsky recovered morphologically different trisomics and chromosome fragments which indicates structural changes and breaks of the chromosomes. The breakage was observed at 1800 and 2500 rentgen units. The recovery of a diploid nematode resistant plant indicates that irradiation may be effective in causing the desired translocation, but a large scale irradiation program will be necessary. Dr. Read investigated transmission through the pollen and one resistant plant was recovered but not authenticated. Both Dr. Savitsky and Dr. Read found little effect of irradiation when seeds were irradiated. Dr. Savitsky found that no difficulties will be encountered in manuplating the monogerm character in conjunction with nematode resistance, and Dr. Read found that the B. procumbens chromosome is not transmitted through the pollen. Dr. Savitsky has recovered two diploid nematode resistant plants and 86 diploid resistant progeny have been obtained. H. Savitsky, J. C. Read.

VULGARES-COROLLINAE HYBRIDS--Ten diploid B_5 plants with high curly top resistance were intercrossed. Eight hundred progeny plants were inoculated with curly top. From these, 14 highly resistant plants and 45 plants with mild symptoms were selected. The 14 highly resistant plants had the appearance of normal sugarbeets and possessed 18 chromosomes. H. Savitsky, J. S. McFarlane.

TOLERANCE TO WILTING CAUSED BY NEMATODES--Lines selected for nematode wilting tolerance by the Instituut voor Rationele Suikerproductie in the Netherlands were evaluated in a heavily nematode-infested test area and in a nematode-free area. The tolerant lines showed less wilting than did US H10B when placed under moisture and nematode stress. Yields of the wilting tolerant selections were substantially superior to those of US H10B when grown under severe nematode infestation (page A18). When grown under nematode-free conditions, no significant differences were observed in root yield between the wilting tolerant selections and US H10B (page A19). These results indicate that progress has been made in the development of wilting tolerant lines which produce higher root yields than unselected lines when grown in severely nematode infested soil. J. S. McFarlane.

DAMAGE CAUSED BY CURLY TOP--A method has been developed for inoculating single plants of sugarbeet in the field with curly top virus which insures a high percentage of infection, whereas noninoculated plants have remained free of the virus at Salinas. High curly top infection and severe damage occurred in US H10B plants inoculated six weeks after seeding. These treatments had root yield reductions ranging from 9% for the 20% inoculated plots to 67% for plots that were 100% inoculated. When plants were inoculated 10 weeks after seeding, the maximum reduction in root yield was 15%. Results from the 1973 field experiment substantiated those obtained in an earlier exploratory study conducted in 1970. The method provides a means of developing an index for estimating the damage caused by curly top in commercial fields of sugarbeets, particularly when infection occurs in young plants. A reliable method of inoculating field plants with curly top should also make it possible to compare the damage caused by combinations of viruses, such as curly top and yellows viruses, with that of the viruses singly and with healthy plants. I. O. Skoyen, J. E. Duffus.

BACTERIAL ROOT ROT STUDIES--Field trials at three locations, Dos Palos, Salinas, and Woodland, showed that new virus yellows resistant varieties are more susceptible to bacterial rot than varieties formerly grown. Bacterial rot does not appear to be associated with virus yellows resistance as was once postulated since two European virus resistant varieties are resistant to bacterial rot. Field inoculation techniques have been developed to study the epidemiology and control of bacterial rot. Tests suggest that susceptible varieties are heterozygous with

respect to susceptibility to bacterial rot; therefore, it should be possible to select for resistance either in the greenhouse or field. Electron micrographs of the pathogen which causes bacterial rot indicate it is an Erwinia species. E. D. Whitney, R. T. Lewellen.

NEMATODE STUDIES--A test to determine the decline of Heterodera schachtii in fallowed plots during a 10 year period after harvest was terminated. Decline of total cyst population was at a constant rate of 7.2% per annum. The average annual decline of viable cysts was 17.9% of the initial population at harvest. Sugarbeet root galls containing viable eggs and larvae of Meloidogyne incognita were found in a fallow field four months after harvest. Tests establish that Beta procumbens is immune to sugarbeet nematode and that trisomic interspecific hybrids of B. vulgaris x B. procumbens are susceptible to Meloidogyne incognita. Interspecific hybrids of B. vulgaris L. and B. procumbens were examined for quantitative and qualitative aspects of resistance to H. schachtii.

In vitro tests established that concentrations of 10-500 ppm Aldicarb inhibit hatching of Heterodera schachtii, but the effect is not sustained when the Aldicarb is removed. Aldicarb is lethal to Heterodera schachtii larvae; the effect is proportional to the concentration of Aldicarb and duration of treatment at each concentration. A. E. Steele.

VARIETY TRIALS, SALINAS, CALIFORNIA, 1972-73

Location: USDA Agricultural Research Station

Soil type: Sandy loam (Chualar series).

Previous crops: Vetch cover crop, 1972; fallow, 1971; barley, 1970.

Fertilizer used: The 1972-73 yield trial field received 1450 lbs/A agricultural dolomite lime (equivalent to 105% $CaCO_3$) broadcast and disced in to about 6" depth. Tests 173, 273, and 373 (bolting evaluation trials) were seeded November 30 and December 1, 1972. Preplant: 700 lbs/A 0:10:5 was broadcast and chiseled in before listing; 90 lbs/A actual N, as ammonium sulfate. Sidedressing: 96 lbs/A actual N, April 13, 1973 and 50 lbs/A actual N, July 3, 1973, both applications as ammonium sulfate.

Tests 473 through 1073 (variety yield trials) were seeded April 3-6, 1973. Preplant: 700 lbs/A 0:10:5 was broadcast and chiseled in before listing; 95 lbs/A actual N, as ammonium sulfate. Sidedressing: 95 lbs/A actual N, as ammonium sulfate, July 3, 1973.

Tests 1173 and 1273 (open-pollinated progeny test and yellows evaluation of self-fertile lines, respectively) seeded April 25, 1973. Preplant: 700 lbs/A 0:10:5 was broadcast and chiseled in before listing; 95 lbs/A actual N, as ammonium sulfate. Sidedressing: 95 lbs/A actual N, as ammonium sulfate, July 5, 1973.

Thinning dates: Tests 173, 273, and 373: February 20-21, 1973.
Tests 473 through 1073: May 7-11, 1973.
Tests 1173 and 1273: May 23-25, 1973.

Inoculation dates: Test 773: July 3, 1973 with combination BYV-BWYV.
Tests 1173 and 1273: July 11, 1973 with combination BYV-BWYV.

Harvest dates: Tests 173 and 373: September 19-20, 1973.
Tests 273, 473, and 573: September 25-26, 1973.
Test 673: October 15-16, 1973. Only blocks 1-10 harvested.
Test 773: October 2-4, 1973.
Test 873: October 1-2, 1973.
Test 973: Not harvested.
Test 1073: September 27-28, 1973. Only 6 replications harvested.
Test 1173: October 17-18, 1973.
Test 1273: October 29-31, 1973.

Irrigation: By either furrow or sprinkler system as required at 10-14 day intervals.

Diseases and insects: Virus yellows infection was moderate during 1973. Aphid populations were controlled and the spread of yellows was slowed by spray applications of Meta-Systox R and Lannate. Tests 1173 and 1273 were sprayed with one lb/A Lannate on May 29 and with 2 pts/A Meta-Systox R on July 13, 1973. Tests 473 through 1073 were sprayed with 2 pts/A Meta-Systox R on July 9, 1973 and test 773 was sprayed a second time with 2 pts/A Meta-Systox R on August 13, 1973. Tests 473 through 1073 were treated with 2% Dylox bait on May 16, 1973, at a rate of 50 lbs/A, for control of a severe infestation of variegated cutworm.

Experimental design: Test 173: 104 entries in one-row plots with 2 replications, plots 32' long.
Test 273: 96 entries in one-row plots with 4 replications, plots 32' long.
Test 373: 26 entries in one-row plots with 5 replications, plots 53' long.
Test 473: 4 entries in one-row plots with 10 replications, plots 53' long.
Test 573: 7 entries in two-row plots with 10 replications, plots 53' long.
Test 673: 25 entries in one-row plots with 10 replications, plots 53' long.
Test 773: 32 entries in split blocks with one-row plots and with 7 replications, plots 37' long.
Test 873: 18 entries in one-row plots with 14 replications, plots 37' long.
Test 1073: 24 entries in one-row plots with 6 replications, plots 37' long.
Test 1173: 18 entries in each of 6 tests with one-row plots and with 4 replications, plots 20' long.
Test 1273: 18 entries in each of 12 tests with one-row plots and with 4 replications, plots 20' long. Duplicate BYV-BWYV inoculated and noninoculated tests were grown.

Sugar analysis: Determined from one or two samples per plot of approximately ten roots each at the sugar analytical laboratory, U.S. Agricultural Research Station, Salinas, California.

Remarks: The assistance of Dr. F. J. Hills and Betsy Tilly, University of California, Davis, in the analysis of test data is gratefully acknowledged.

Tests 173, 273, and 373

These tests were planted primarily to obtain bolting tendency evaluations of breeding lines and experimental hybrids. Secondarily, these tests are used to obtain yield performance data.

These three tests should have good reliability for the bolting data. In comparison with previous years, the level of bolting was less. This may have been caused by a two week later planting date than usual. However, the relative differences between these lines and hybrids appear to be indicative of their bolting or non-bolting tendency.

The yield performance data for Tests 173 and 273 may be marginal because of the large number of varieties and the low number of replications. The performance data for Test 373, however, should be a good indication of how these hybrids perform when planted very early in the season.

Bolting resistant selections from C0705, C0705HO, Y001, Y022, and C813 were evaluated. The selections from these lines generally showed a lower bolting percentage. It is not known, however, how much of this difference is due to inherited non-bolting tendency or to environmental effects resulting from the conditions under which seed production occurred.

Tests 673, 773, 873, 973, and 1073

In general, these tests gave very poor results and the data are probably unreliable. Tests 673 through 1073 should have been planted in January but due to continuous rainy weather and wet soil conditions were not planted until April. The loss of two to three months of growing season resulted in much lower yields than we normally expect for Salinas variety trials. Because the seed beds were wet and not properly reworked, root growth was generally shallow, and roots were short and stubby with more sprangling than usual. Following thinning, a variegated cutworm infestation reduced stands in all of these tests and caused severe problems in Tests 973 and 1073. Test 973 was not harvested and only 6 of the 14 replications of 1073 were harvested.

All of these tests were designed as split-blocks to evaluate breeding lines and hybrids for performance under both BYV-BWYV inoculated (infected) and noninoculated (noninfected) conditions. Because of the late planting date, the early natural spread of yellows, and the difficulty experienced in raising aphid vectors, only Test 773 was inoculated with BYV-BWYV. Test 773 gave very unreliable yellows evaluation data that indicated that there were no variety x virus treatment interactions, even though a range of susceptible to resistant lines were used.

The most important conclusion gained from these tests is that sugarbeet variety trials in the Salinas area need to be planted early in the season.

Tests 1173 and 1273

The purpose of Test 1173 was to identify the superior genotypes out of 92 progenies evaluated under BYV-BWYV infected conditions. The data for this test are not included in tabular form in this report, but they will be summarized when the new intercross populations are evaluated. This test is part of a series of tests to be conducted to determine if certain types of progeny test schemes can be employed that more accurately identify yellows resistant segregates than mass selection, particularly within self-fertile populations.

The purpose of Test 1273 was to evaluate a large number of self-fertile and inbred lines for yellows reaction and to determine the performance of these lines when not used in hybrid combinations. The reliability of this test should be fairly good. The noninoculated portion of the test remained essentially yellows free throughout the season. However, some problems were encountered in the inoculated portions of this test. The beets grew very slowly in small areas that had been chemically treated for morning glory control in 1972. These slow growing beets may have exaggerated the actual difference between the inoculated and noninoculated lines, particularly within Tests 7 and 8.

Because of the large number of entries, the lines in this test were divided into six separate tests with four replications each. These six tests were duplicated and one set was inoculated with BYV-BWYV and the other set was used as noninoculated checks. Statistical comparisons between the various tests and particularly between the inoculated and noninoculated tests can not be made, but the relative levels of performance under the two virus treatments should give a general indication of the yellows reaction of these various lines.

In general, the self-pollinated lines show a greater yellows loss than might be expected based on their respective outcrossed equivalents. Probably part of this increased loss results from their lack of vigor. Root and gross sugar yield are usually negatively correlated with disease reaction to yellows as measured by percent loss data. For example, in Test 1273 the lines 2775, 2776, and 2777 were derived by selfing from 1230, 1231, and 1232, respectively. These less vigorous selfed lines show greater loss due to yellows than do their more vigorous parents. If this is a true relationship, the yellows resistance of a hybrid derived from inbred or self-fertile lines may show greater resistance than expected. This relationship between yield and loss due to yellows infection is being studied in greater detail.

TEST 173. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1972-73

2 replications
1 row plots, 32 ft. long

Planted: November 30, 1972
Harvested: September 20, 1973

Variety	Description	Acre Yield Sugar Pounds	Acre Yield Beets Tons	Sucrose Percent	7/16 Bolting Percent	8/13 Bolting Percent	9/10 Bolting Percent	Beets/ 100' Number	Multiple Crowns Grade	Spran-gling Grade	Shape Grade
2705	BRS 0705	6,900	21.96	15.9	8.2	9.3	9.3	150	2.0	3.0	4.0
2705HO	BRS 0705HO x BRS 0705	9,570	28.80	16.7	5.6	6.4	6.4	164	2.5	2.5	2.0
2718	Inc. 1718	7,720	25.44	15.2	14.1	22.6	23.8	139	2.5	2.5	2.0
2718HO	1718HO x 1718	11,420	35.40	16.1	13.6	18.3	21.2	158	2.5	2.5	1.5
1718	Inc. 9718	6,900	22.32	15.5	27.2	30.3	32.6	148	2.5	2.0	2.0
1718HO	9718HO x 9718	10,790	35.40	15.4	10.8	19.0	19.0	145	3.0	2.0	1.5
F71-705	Inc. C0705	5,940	18.60	16.0	32.7	36.0	38.6	161	2.5	2.5	3.5
F71-705HO	C0705HO x C0705	7,770	24.24	16.1	33.2	38.6	43.0	173	2.5	2.0	2.5
1705	Inc. 9705	5,810	18.06	16.1	32.8	31.5	31.5	128	2.0	3.0	3.0
1705HO	0705HO x 9705	7,940	24.24	16.4	34.7	41.1	44.2	148	2.0	2.0	3.0
1230	0792aa x 700mm series	8,820	28.08	15.8	30.7	38.8	40.1	144	2.5	3.0	2.5
1231	0793aa x 700mm series	10,360	33.18	15.7	28.9	33.7	38.1	161	2.5	2.5	2.0
1232	0797aa x 700mm series	10,820	36.12	15.0	23.6	28.2	30.2	155	3.0	2.5	1.5
0716	Inc. 9716-11mm	6,430	23.28	13.8	27.7	34.0	34.0	141	1.5	2.0	1.5
7716	Inc. 6716	8,850	29.76	15.0	0.0	0.0	0.0	153	1.5	2.0	2.0
7716HO	6716HO x 6716	11,380	39.36	14.6	1.8	2.7	3.6	173	2.0	2.5	1.5
0724	Inc. 9724	7,330	23.52	15.6	17.5	22.6	27.0	152	2.5	3.0	2.5
2708	1708mm⊗(MM x 700mm)	6,060	18.24	16.6	0.8	1.7	1.7	184	2.0	2.5	3.5
2709	1709mm⊗(mm x 700MM)	6,340	20.88	15.2	14.4	16.3	20.2	163	3.0	4.0	3.0
2710	1710mm⊗(711 x 500mm)	9,260	28.68	16.2	15.4	18.2	20.2	163	3.0	2.5	1.5
2713	1713mm⊗(723 x 500mm)	6,810	21.90	15.6	26.6	35.7	45.3	183	2.5	2.5	3.0
2730	1730mm⊗(13 x 500mm)	6,630	21.48	15.4	17.1	19.9	20.9	166	2.5	4.0	3.5
2731	1731mm⊗(Y04 x 500mm)	7,820	25.74	15.4	26.0	29.4	29.4	186	2.0	3.0	3.0
2733	1733mm⊗(Y01 x 500mm)	6,900	22.02	15.8	11.0	15.3	18.6	144	2.0	2.0	3.0
2736	1736mm⊗(MM x 500mm)	6,900	23.88	14.7	19.8	21.6	24.3	173	1.5	2.0	2.0
2737	1737mm⊗(MM x 800mm)	6,400	21.72	14.8	16.4	18.4	18.4	161	2.0	2.5	2.5
2770	1770mm⊗	7,230	24.36	15.1	7.7	12.7	13.8	148	2.0	2.5	3.0
2774	1774mm⊗	7,710	25.68	15.3	11.7	17.2	17.2	173	2.0	4.0	3.5
2775	1230mm⊗	6,930	22.02	15.8	13.4	16.2	18.9	166	3.0	3.5	3.0
2776	1231mm⊗	7,330	24.18	15.3	20.5	25.9	25.9	175	2.0	2.5	3.0

TEST 173. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1972-73 continued

Variety	Description	Acre Yield Sugar Pounds	Acre Yield Beets Tons	Sucrose Percent	7/16 Bolting Percent	8/13 Bolting Percent	9/10 Bolting Percent	Beets/ 100' Number	Multiple Crowns Grade	Spran-gling Grade	Shape Grade
2777	1232mm⊗	8,220	26.76	15.5	7.4	8.3	11.1	169	1.5	2.0	2.0
2792	1792mm⊗(mm x 700MM)	6,880	22.20	15.5	22.9	25.9	26.9	155	2.5	3.0	4.0
2793	1793mm⊗(MM x 700mm)	6,900	21.12	16.3	16.2	18.2	20.1	163	2.0	2.0	2.0
2794	1794mm⊗(MM x 500mm)	6,500	20.64	15.8	14.3	20.1	25.8	164	2.5	2.5	2.5
2795	1795mm⊗(MM x 800mm)	6,180	19.68	15.7	27.7	30.8	35.7	156	2.5	4.0	3.5
2797	1797mm⊗(711 x 500mm)	7,990	26.04	15.4	26.9	33.5	36.2	169	2.5	2.0	3.5
2798	1798mm⊗(mm x 13)	6,340	21.18	15.0	13.2	14.2	20.8	166	2.0	3.0	3.0
2755ma	1755mmaa x 1755A	11,490	40.02	14.5	28.5	31.5	39.6	153	3.0	2.5	2.0
2791m	Inc. 1792,3,7,8mm	8,430	30.84	13.8	26.7	26.7	35.6	158	3.0	2.5	2.0
2755C1	1755-1,2,...,19mm⊗	7,210	24.36	14.8	27.3	31.1	21.3	159	3.0	4.5	3.5
2758-1	YRS 0758-1C1mm	7,660	24.72	15.5	0.0	0.0	0.0	170	3.5	3.0	3.0
2758-3	YRS 0758-3C1mm	7,010	22.08	16.3	8.5	9.5	12.3	166	3.0	3.5	3.0
2758-4	YRS 0758-4C1mm	8,860	30.96	14.4	27.8	36.4	36.4	159	3.0	3.0	2.5
2769	YRS 0769	5,050	15.48	16.3	41.1	43.0	47.8	164	2.5	3.0	3.0
2778	YRS 0778-1,2C1	6,780	21.84	15.6	25.4	29.5	30.5	153	3.0	2.0	2.5
2779	YRS 0779C1	5,610	18.12	15.5	18.6	22.5	25.5	159	3.0	3.5	3.0
2780	YRS 0780-1C1	8,500	29.52	14.4	12.2	20.6	24.4	127	2.0	2.0	1.0
2781	YRS 0781-1C1	6,380	20.76	15.4	2.0	2.0	2.0	161	4.5	3.5	5.0
2783	YRS 0783-1,2C1	10,210	32.46	15.7	30.1	30.0	32.1	156	2.0	3.0	2.0
2784	YRS 0784-1C1	6,410	20.04	16.0	4.9	4.9	4.9	159	3.0	3.0	3.0
2786	YRS 0786-1,2C1	9,900	31.44	15.9	11.2	12.2	12.2	155	2.0	2.5	1.5
2787	YRS 0787C1, 0791C1	5,970	22.08	13.6	23.1	25.6	28.2	122	2.0	2.5	2.0
2788	YRS 0788C1, 0789C1	7,320	23.64	15.5	3.1	5.2	5.2	152	2.5	3.0	3.0
2213	BMRS 1235S(Y01)	11,830	40.20	14.8	51.2	51.1	57.2	169	3.0	1.5	1.0
2214	BMRS 1236S(Y04)	11,590	37.86	15.5	34.0	38.7	43.4	166	3.0	2.5	2.5
2215	BMRS 1237S(10)	11,090	36.36	15.4	28.9	37.7	39.5	163	2.5	2.5	1.5
2216	BMRS 1238S(13)	10,220	35.04	14.6	15.1	18.0	18.0	167	2.0	1.5	1.5
2217	BMRS 1239S(21)	9,570	33.84	14.2	33.8	38.0	42.7	161	3.0	2.0	2.0
2218	BMRS 1240S(44)	13,150	44.88	14.7	10.2	11.9	15.6	169	1.5	1.5	1.0
2219	BMRS 1241S(40)	7,350	26.28	14.0	62.4	71.2	78.7	167	3.5	3.5	3.0
2220	BMRS 1242S(60)	7,100	23.04	15.4	14.5	16.6	17.6	152	5.0	5.0	3.5

TEST 173. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1972-73 continued

Variety	Description	Acre Yield Sugar Pounds	Acre Yield Beets Tons	Sucrose Percent	7/16 Bolting Percent	8/13 Bolting Percent	9/10 Bolting Percent	Beets/ 100' Number	Multiple Crowns Grade	Spran-gling Grade	Shape Grade
2221	BMRS 1243S(61)	8,140	29.76	13.7	27.7	29.8	42.8	158	3.5	2.0	2.0
2222	BMRS 1244S(9101)	8,880	31.68	14.0	13.2	19.5	22.5	155	2.5	1.5	1.5
2223	BMRS 1235F⊗(Y01)	10,520	36.36	14.5	4.6	4.6	10.2	167	2.5	1.5	1.5
2224	BMRS 1236F⊗(Y04)	9,210	32.88	14.0	13.8	13.8	13.8	159	1.5	2.0	2.5
2225	BMRS 1237F⊗(10)	10,310	36.00	14.4	15.6	23.5	27.5	159	2.5	2.0	1.5
2226	BMRS 1238F⊗(13)	9,120	30.96	14.8	17.3	17.3	17.3	163	2.5	2.5	2.0
2228	BMRS 1240F⊗(44)	7,930	30.00	13.7	56.8	68.4	68.4	117	4.5	2.5	3.0
2230	BMRS 1243F⊗(61)	4,770	17.82	13.3	36.0	35.8	35.8	134	2.0	4.5	3.5
2232	BMRS 1244F⊗(9101)	10,220	35.04	14.6	9.6	17.4	18.5	148	1.5	1.0	2.0
2233	BMRS 1245⊗(1770)	4,840	18.12	13.4	76.4	78.3	80.0	173	4.5	4.5	5.0
2234	BMRS 1246⊗(1771)	8,480	27.00	15.7	36.8	41.6	42.4	167	4.0	3.5	3.5
2235	BMRS 1247⊗(1773)	7,280	23.52	15.5	52.3	63.7	63.7	152	3.5	4.0	4.5
2236	BMRS 1248⊗(1774)	10,090	35.52	14.2	30.5	37.4	38.5	155	3.5	2.5	2.0
2237	BMRS 1251⊗(9101)	3,810	13.50	14.1	60.3	61.4	65.7	145	3.0	2.5	4.0
2238	BMRS 1252⊗(13)	3,800	15.36	12.4	86.2	91.7	91.7	169	3.5	5.0	5.0
2522-29H21	1536HO x 8522-29C2	8,380	29.22	14.3	39.5	48.5	49.8	106	2.5	3.5	2.5
2522-29H23	0522H52 x 8522-29C2	6,870	24.48	14.0	25.2	28.1	29.1	158	2.5	3.0	2.0
0502	Inc. F56-502	6,870	24.96	13.7	15.7	21.5	22.4	159	2.0	2.5	2.5
0502HO (I)	F59-502HO x F56-502	8,230	28.68	14.3	25.0	31.8	33.0	138	2.0	2.5	2.0
1502 (S)	Inc. 0502	6,440	24.00	13.4	26.9	32.1	35.9	122	2.0	4.0	3.5
1502HO (S)	0502HO x 0502	6,480	22.20	14.5	26.8	28.3	31.3	111	2.0	2.0	2.0
2502HO (I)	1502HOA x 0502	6,950	23.10	15.0	2.6	2.6	2.6	125	2.0	3.0	2.5
2512	Inc. 1512-1	6,850	24.78	13.8	0.0	0.0	0.0	161	3.5	4.0	3.0
2523	Inc. 1117	10,490	36.72	14.3	6.5	8.3	13.0	169	1.5	1.5	1.0
2524	Inc. 1118	12,330	42.00	14.7	8.9	11.6	14.3	175	1.0	3.0	1.0
2547	Inc. 1547-1	5,470	16.80	16.3	0.0	0.0	0.0	170	2.0	2.5	3.5
2554 (I)	Inc. 1554-1	5,710	18.96	15.0	3.4	3.4	4.5	141	2.0	1.5	1.5
2554 (S)	Inc. 0554	9,150	30.42	15.0	7.5	9.4	11.2	167	2.0	2.5	1.5
2562	Inc. 0562-1	4,790	15.96	15.0	35.9	43.4	47.0	170	2.0	2.0	4.0
F66-562HO	562HO x 562(K)	8,900	30.12	14.8	14.4	24.4	24.4	141	2.0	1.5	1.5
F67-564	Inc. 5564	5,440	18.78	14.4	46.3	52.9	59.6	109	2.5	3.5	4.0

TEST 173. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1972-73 continued

Variety	Description	Acre Yield Sugar Pounds	Acre Yield Beets Tons	Sucrose Percent	7/16 Bolting Percent	8/13 Bolting Percent	9/10 Bolting Percent	Beets/ 100' Number	Multiple Crowns Grade	Spran-gling Grade	Shape Grade
F67-564HO	5564HO x 5564	7,380	26.04	14.1	34.9	45.9	55.0	136	2.5	3.5	3.5
1565	Inc. C9564	5,910	19.32	15.3	29.8	30.8	38.9	158	2.0	2.5	3.5
1565HO	F68-564HO x C9564	7,040	23.40	15.0	41.2	45.2	49.2	156	2.0	3.0	3.5
2563aa	1563aa x 1563Aa	7,010	22.44	15.6	9.2	15.4	16.4	152	2.0	3.5	2.5
2522-29	Inc. 8522-29C2	5,140	17.88	14.4	7.6	8.7	11.9	147	1.0	3.0	3.0
1536-21	Inc. 8536-21C2	5,340	18.12	14.8	46.2	52.1	57.0	161	2.5	3.5	3.5
2536-97HO	1536HO x 8536-97	8,760	28.44	15.4	7.0	14.1	15.8	177	2.0	2.5	2.0
218	Inc. 118 Composite	11,180	37.02	15.1	10.7	12.3	14.8	188	1.5	2.5	1.0
218-8	Inc. salt sel. 118-8	9,870	31.62	15.6	1.8	1.8	3.5	180	2.0	2.5	2.5
218-20	Inc. salt sel. 118-20	11,420	40.20	14.2	2.0	5.0	6.0	172	2.5	2.5	2.5
218-38	Inc. salt sel. 118-38	10,330	36.12	14.3	0.8	2.6	5.2	178	1.5	2.0	1.0
6512	Inc. 5512-1 (NB6)	6,070	23.52	12.9	0.0	0.9	0.9	164	3.5	4.0	3.0
Mean		7,820	26.19	15.0	22.3	26.2	28.5	156	2.5	2.7	2.6
LSD (.05)		2,277	7.73	1.64	13.6	15.4	17.3	23.9	1.7	1.5	1.5
Coefficient of Variation (%)		14.7	14.9	5.5	30.7	29.7	30.5	7.7	35.0	28.6	29.5
F value		5.9**	6.0**	2.1**	11.6**	10.5**	9.2**	3.5**	1.4*	2.2**	3.0**

*Exceeds the 5% point of significance (F = 1.35).
**Exceeds the 1% point of significance (F = 1.53).

TEST 273. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1972-73

4 replications
1 row plots, 32 ft. long

Planted: November 30, 1972
Harvested: September 25, 1973

Variety	Description	Acre Yield Sugar Pounds	Acre Yield Beets Tons	Sucrose Percent	7/16 Bolting Percent	8/13 Bolting Percent	9/10 Bolting Percent	Root Rot Percent	Mildew Percent	Beets/ 100' Number
3-way Hybrids										
223-3H8	F70-546H3 x 123-3	13,640	41.49	16.4	6.6	8.4	13.6	0.5	0.0	177
223-2H8	F70-546H3 x 123-2	13,530	41.73	16.2	8.0	12.3	14.6	0.0	0.0	164
223-2H16	F69-546H5 x 123-2	13,160	40.74	16.2	14.3	15.1	15.5	0.0	1.3	174
Y222H69	0705H5 x Y022	12,650	36.90	17.2	6.6	10.4	13.2	0.9	0.9	163
223-1H16	F69-546H5 x 123-1	12,450	37.08	16.7	9.7	10.6	12.8	0.0	0.0	177
223-1H8	F70-546H3 x 123-1	12,310	38.67	16.0	8.5	11.0	14.4	0.0	0.0	179
217H16	F69-546H5 x 813	12,250	37.41	16.4	7.8	9.3	12.1	0.4	0.0	165
217H69	0705H5 x 813	11,940	36.84	16.3	5.5	7.8	10.9	0.0	0.9	171
Y204H69	0705H5 x Y104A,B	11,930	35.40	16.9	13.2	16.1	19.4	2.3	0.5	164
223-3H16	F69-546H5 x 123-3	11,770	35.88	16.4	9.9	12.5	14.2	0.4	0.9	181
2773H8	F70-546H3 x 1773a	11,700	36.84	16.0	19.7	22.9	23.4	0.4	0.9	166
117H45	7718H31 x 813	11,690	36.42	16.1	9.8	14.2	16.2	0.0	0.5	159
Y204H16	F69-546H3 x Y104A,B	11,580	33.60	17.2	7.7	11.4	11.4	1.3	1.8	163
Y204H83	1724H72mm x Y104A,B	11,550	33.78	17.1	15.2	21.7	26.1	0.5	0.0	144
US H10B	546H3 x F70-17(1068)	11,100	33.81	16.5	6.2	6.8	11.1	1.3	0.4	170
Y227H69	0705H5 x Y127	11,060	35.94	15.4	12.9	16.2	19.3	0.4	0.4	182
Y222H83	1724H72 x Y022	11,050	33.96	16.2	11.6	13.1	16.2	0.0	3.7	158
2773H82	1718H54 x 1773a	11,010	33.87	16.3	14.1	17.1	19.8	1.6	1.1	155
217H83	1724H72 x 813	10,980	33.87	16.3	8.4	10.8	11.8	1.4	2.8	164
2791H82	1718H54 x 1792,3,7,8	10,640	33.72	15.7	18.6	21.2	23.9	1.4	0.0	176
2755H79	1705H72mm x 1755	10,520	32.37	16.3	18.5	22.6	23.9	0.4	0.9	168
2773H69	0705H5 x 1773a	10,260	32.10	16.2	13.1	16.4	18.9	1.9	1.9	159
2791H8	F70-546H3 x 1792,3,7,8	10,050	29.46	17.1	10.8	14.1	17.4	0.0	0.0	164
2773H79	1705H72mm x 1773a	9,920	30.96	16.0	13.1	14.1	16.6	1.8	2.7	157
2791H79	1705H72mm x 1792,3,7,8	9,920	31.35	15.9	8.4	14.7	19.4	0.5	1.7	169

TEST 273. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1972-73 continued

Variety	Description	Acre Yield Sugar Pounds	Acre Yield Beets Tons	Sucrose Percent	7/16 Bolting Percent	8/13 Bolting Percent	9/10 Bolting Percent	Root Rot Percent	Mildew Percent	Beets/ 100' Number
2755H8	F70-546H3 x 1755	9,820	29.70	16.5	16.1	18.5	20.4	2.6	0.0	164
217H75	1724H54 x 813	9,800	29.61	16.6	6.6	8.4	8.4	2.4	2.4	166
2755H5	F68-564H0 x 1755	9,100	28.26	16.1	17.6	22.8	25.2	1.0	0.5	165
2791H5	F68-564H0 x 1792,3,7,8	8,860	26.94	16.5	11.1	12.1	14.2	0.9	0.0	153
2755H82	1718H54 x 1755	8,700	27.15	16.1	19.6	22.5	27.0	0.0	1.9	159
Open-pollinated Lines										
Y229/2	YRS 713A (G.S.)	11,650	36.33	16.0	1.7	4.3	5.6	1.2	3.0	182
Y231	BRS Y001A,B	11,570	34.65	16.8	7.8	9.8	11.7	0.9	0.9	161
Y233	BRS Y022	11,420	36.30	15.7	4.2	8.6	9.0	2.3	0.7	160
223-2	Inc. 123-2	11,360	37.47	15.2	9.4	10.3	12.6	0.0	0.0	173
Y003	Inc. Y803	11,180	32.82	17.1	8.0	9.9	11.3	1.0	7.3	159
F71-17	Inc. F70-17	11,120	34.44	16.2	3.9	6.3	9.7	0.5	1.0	163
216	Imp. Val. sel. 916	11,090	35.13	15.8	4.9	5.9	6.3	0.9	0.0	162
123-1	Inc. 023-1	11,040	34.77	15.8	1.5	4.4	5.4	0.5	1.0	157
Y229/1	YRS 713A (% S.)	10,920	32.79	16.7	5.2	7.1	8.0	0.0	0.0	168
223-1	Inc. 123-1	10,880	37.08	14.9	6.7	10.3	11.6	0.5	1.6	173
Y211	F_4B_1(mm x Y03)mm	10,660	31.65	16.9	1.2	3.3	5.0	2.9	2.9	136
Y201	YRS Y001A,B	10,630	33.03	16.1	30.6	39.4	42.3	2.2	1.8	170
Y222A	YRS Y022	10,610	33.45	15.9	7.3	8.9	10.5	0.0	1.1	152
F70-17	Inc. C813	10,550	33.30	16.1	6.6	11.0	12.0	0.5	1.5	162
Y207	F_4B_1(mm x Y04)mm	10,490	33.84	15.6	16.3	22.7	24.4	3.6	0.0	133
Y204	Inc. Y104A,B	10,340	32.31	16.0	19.3	27.1	32.2	2.7	4.9	154
813 Ore.	Inc. 713A	10,270	31.26	16.4	3.2	3.7	4.2	1.9	1.0	168
Y232	BRS 813	10,270	31.59	16.4	3.3	4.8	5.2	0.0	0.9	166
123-3	Inc. 023-3	10,260	33.78	15.3	3.3	6.1	7.0	0.0	2.3	167
217 Sp.	Inc. 813 Ore.	10,240	32.73	15.6	4.9	5.8	8.3	0.5	2.0	163
123-2	Inc. 023-2	10,200	31.98	16.0	7.3	8.6	9.5	0.0	0.0	171

TEST 273. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1972-73 continued

Variety	Description	Acre Yield Sugar Pounds	Acre Yield Beets Tons	Sucrose Percent	7/16 Bolting Percent	8/13 Bolting Percent	9/10 Bolting Percent	Root Rot Percent	Mildew Percent	Beets/ 100' Number
F70-13	Inc. F66-413	10,190	31.89	16.0	14.2	18.7	21.4	1.8	0.9	170
Y234-1,2	F_2(713A x FC 701/2)	10,130	32.43	15.7	16.0	22.0	23.1	0.0	5.0	163
Y227	Inc. Y127	10,100	30.72	16.5	4.4	5.9	5.9	0.5	1.0	162
Y222	Inc. Y022	9,950	32.46	15.4	14.3	19.3	19.3	0.0	0.4	170
217T	Inc. 917T, 117T	9,860	31.70	15.8	4.4	6.6	8.6	1.4	0.0	111
Y101	Inc. Y001A,B	9,820	32.10	15.3	36.2	45.1	46.1	1.0	2.7	154
868	Inc. F57-68(US 75)	9,700	32.01	15.2	16.3	18.7	20.0	1.9	0.0	170
413C	Inc. 313	9,680	30.48	15.8	4.4	6.4	7.9	0.0	0.5	162
F66-64	Inc. 264	9,440	30.33	15.6	10.1	11.4	12.4	1.0	3.7	170
223-3	Inc. 123-3	9,210	29.43	15.6	9.2	10.7	13.1	0.5	0.0	163
Y235	F_2(713A x FC 702/2)	9,140	29.55	15.5	32.7	40.0	43.1	1.8	1.8	170
Y210	F_4B_1(mm x 10)mm	8,960	28.11	16.0	18.6	27.7	28.7	1.5	2.5	154
Y208	F_4B_1(mm x 13)mm	8,890	27.75	16.0	6.9	13.1	19.5	0.6	1.3	137
Y236	F_2(Y022 x FC 701/2)	8,830	28.83	15.3	22.1	25.7	30.6	2.2	6.1	173
Y237	F_2(Y022 x FC 702/2)	8,790	27.96	15.8	33.5	39.9	41.3	0.9	0.5	170
Y206	F_4B_1(mm x Y01)mm	7,970	25.44	15.6	35.4	41.7	46.4	3.3	3.9	143
Y238	F_2(813 x SP6822-0(B))	7,760	26.58	14.7	60.1	66.1	68.3	1.3	0.4	169
Self-fertile Composites										
2755Ma	1755Maa x A	11,000	36.36	15.1	18.3	22.5	25.4	0.0	2.1	146
2773Ba	YRS 0773aa x A	10,600	32.76	16.2	3.2	7.0	8.1	3.8	10.0	142
2773a	1773aa x A	10,520	32.70	16.1	15.1	16.8	18.6	1.0	1.7	152
2771Ba	YRS 0771aa x A	9,920	33.39	15.1	8.3	11.6	13.1	0.0	2.6	170
2774Ba	YRS 0774aa x A	9,530	29.49	16.2	11.7	15.3	15.8	1.1	3.7	151
2791Ma	1792,3,7,8aa x A	9,180	29.97	15.3	12.9	16.2	16.8	1.2	2.7	138
1797Ma	0797Maa x A	9,070	28.56	15.8	21.0	26.7	26.7	1.4	2.3	164
2770BA	YRS 0770	8,840	27.57	16.1	6.5	8.8	9.2	0.6	3.7	163
1793Ma	0793Maa x A	8,750	27.15	16.2	19.8	20.4	21.7	1.8	0.0	159

TEST 273. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1972-73 continued

Variety	Description	Acre Yield Sugar Pounds	Acre Yield Beets Tons	Sucrose Percent	7/16 Bolting Percent	8/13 Bolting Percent	9/10 Bolting Percent	Root Rot Percent	Mildew Percent	Beets/ 100' Number
1798Ma	0798Maa x A	8,630	27.24	15.8	8.8	15.7	17.6	1.0	6.0	169
2773BA	YRS 0773	8,620	27.69	15.6	6.7	8.6	9.0	1.9	5.6	154
2771BA	YRS 0771	8,510	27.63	15.4	23.0	25.3	26.2	0.4	0.5	171
2770Ba	YRS 0770aa x A	8,460	26.97	15.7	17.5	21.6	25.1	1.9	1.0	166
2773A	Inc. 1773a	8,340	26.49	15.8	11.1	14.7	14.7	1.4	6.4	135
1792Ma	0792Maa x A	8,070	25.83	15.7	30.5	33.3	36.3	0.0	1.3	164
2791A	Inc. 1792,3,7,8	7,990	25.44	15.7	15.2	19.2	19.2	1.0	3.0	141
2774BA	YRS 0774	7,500	23.94	15.7	13.4	18.8	19.2	1.5	4.3	161
F_1 Hybrids										
2554H1	0502H0 x 0554	12,300	36.63	16.8	4.3	6.4	9.2	0.0	0.0	150
1705H72	9718H0 x 9705	11,590	37.32	15.5	22.0	26.3	26.8	1.6	1.1	148
1724H72	9718H0 x 9724	11,330	36.42	15.5	28.3	36.2	42.4	1.1	0.6	152
2718H54	1705H0 x 1718	10,770	33.48	16.1	14.4	22.0	24.7	1.5	3.7	163
2718H84	1724H0 x 1718	10,700	33.84	15.9	17.1	23.1	26.2	2.1	0.8	170
1718H54	0705H0A x 9718	10,350	31.35	16.5	15.0	21.4	22.4	1.5	1.1	155
0705H5	F68-564H0 x 9705	9,100	29.16	15.6	40.2	52.7	54.4	0.0	0.0	158
1718H52	8522H1 x 9718	7,690	23.67	16.2	15.1	18.2	21.1	1.6	0.5	157
2718H5	F68-564H0 x 1718	7,340	23.13	15.8	25.5	29.9	37.1	0.0	0.0	154
1718H5	F68-564H0 x 9718	6,720	21.66	15.6	31.7	36.4	42.1	2.6	1.8	152
Mean		10,190	31.90	16.0	13.8	17.4	19.5	1.1	1.7	161
LSD (.05)		1,728	5.60	1.12	8.1	9.2	10.0	NS	4.4	18.2
Coefficient of Variation (%)		12.2	12.6	5.0	42.3	37.8	36.7	170.3	184.4	8.1
F value		5.4**	4.4**	1.6**	11.4**	11.8**	10.9**	NS	1.4*	3.4**

*Exceeds the 5% point of significance (F = 1.32).
**Exceeds the 1% point of significance (F = 1.48).

TEST 373. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1972-73

5 replications
1 row plots, 53 ft. long

Planted: December 1, 1972
Harvested: September 20, 1973

Variety	Description	Acre Yield		Sucrose	7/16 Bolting	8/13 Bolting	9/10 Bolting	Root Rot	Beets/ 100'	Mildew
		Sugar Pounds	Beets Tons	Percent	Percent	Percent	Percent	Percent	Number	Percent
217TH8	F70-546H3 x 917T	13,800	42.51	16.2	7.7	10.2	13.5	0.3	143	0.0
217H8	F70-546H3 x 813	13,390	38.99	17.2	5.3	7.5	9.2	0.0	151	0.0
217H80	1718H5 x 813	13,310	41.04	16.2	7.5	10.0	11.8	1.0	147	0.0
Y204H79	1705H72mm x Y104A,B	13,280	40.15	16.6	13.5	19.5	23.9	1.2	144	0.3
217H82	1718H54 x 813	13,260	39.31	16.9	4.5	9.5	10.8	0.5	151	0.5
217H79	1705H72mm x 813	13,170	39.17	16.9	6.3	9.2	11.3	1.0	140	0.8
217TH52	8522H1 x 917T	12,930	37.91	17.1	2.2	4.2	6.4	0.8	137	0.3
217H52	8522H1 x 813	12,920	40.68	15.9	6.0	8.7	10.9	0.0	143	0.3
217H81	1718H52 x 813	12,900	38.66	16.7	4.2	7.3	9.5	0.8	145	0.5
813H8	546H3 x 713A	12,880	38.99	16.5	7.6	10.6	11.8	1.3	143	0.0
217TH62	8536H1 x 917T	12,860	39.22	16.4	8.8	12.9	15.4	0.2	147	0.8
Y204H81	1718H52 x Y104A,B	12,830	39.79	16.1	10.3	15.9	18.1	0.8	146	0.0
Y204H82	1718H54 x Y104A,B	12,760	37.34	17.1	20.8	27.6	32.0	1.3	153	1.4
Y204H8	F70-546H3 x Y104A,B	12,750	39.63	16.1	12.4	17.4	20.6	0.8	148	0.0
Y227H8	F70-546H3 x Y127	12,580	38.90	16.2	6.5	10.8	13.5	0.0	156	0.0
US H10A	569H3 x F70-17 (1231)	12,490	37.37	16.7	11.2	15.7	18.6	1.4	152	1.1
Y222H8	F70-546H3 x Y022	12,430	38.17	16.3	11.6	14.6	16.6	0.5	152	0.3
217H78	1705H62 x 813	12,390	37.88	16.3	8.8	11.4	14.8	0.5	144	0.0
217H62	8536H1 x 813	12,370	36.54	16.9	8.1	12.6	15.6	0.0	151	0.0
Y222H79	1705H72mm x Y022	12,060	36.81	16.4	14.0	15.5	16.5	1.2	147	1.0
U913H4	569H3 x F68-13 (US H9A)	12,000	37.55	16.0	15.6	19.3	21.0	0.5	141	0.0
U913H8	546H3 x F68-13 (US H9B)	11,950	36.72	16.3	19.0	21.1	25.3	0.0	146	0.0
Y227H79	1705H72 x Y127	11,890	37.84	15.7	9.3	13.5	14.2	0.3	147	0.7
Y101H8	546H3 x Y001A,B	11,830	37.34	15.9	21.6	31.5	33.5	0.5	129	0.0
US H10B	546H3 x F70-17 (1068)	11,760	36.41	16.2	10.8	13.5	15.7	0.5	168	0.0
664H8	546H3 x 64 (US H7A)	10,530	32.08	16.4	9.7	11.9	12.4	0.2	154	0.0
Mean		12,590	38.35	16.4	10.1	13.9	16.3	0.6	147	0.3
LSD (.05)		1,194	3.27	0.87	5.4	5.2	5.5	NS	15.1	NS
Coefficient of Variation (%)		7.6	6.8	4.2	42.1	29.9	27.2	162.1	8.2	284.9
F value		2.57**	2.83**	1.65*	6.8**	10.9**	11.1**	NS	1.8*	NS

*Exceeds the 5% point of significance (F = 1.63).
**Exceeds the 1% point of significance (F = 1.98).

NEMATODE WILTING TEST, SALINAS, CALIFORNIA, 1973

(10 replications of each variety)

Planted: May 3, 1973
Harvested: October 10, 1973

Variety	Description	Acre Yield Sugar Pounds	Acre Yield Beets Tons	Sucrose Percent	Harvest Count Number	Wilting Grade 1/
RW 290	Sel. from Netherlands	3,190	9.95	16.0	140	4.3
RW 768	Sel. from Netherlands	3,150	10.28	15.2	130	4.1
RW 610	Sel. from Netherlands	3,040	10.17	14.9	130	1.9
RW 280	Sel. from Netherlands	2,690	9.17	14.7	133	4.5
US H10B	Commercial variety	1,630	5.96	13.6	115	6.0
Mean		2,740	9.10	14.9	Beets	
LSD (.05)		613	1.89	0.49	per	
Coefficient of Variation (%)		24.66	22.89	3.66	100'	
F value		9.31**	7.55**	24.92**	row	

**Exceeds the 1% point of significance (F=3.89)

1/ 1 = No wilting, 10 = Severe wilting. Grade is average of ratings made 7/25, 7/26, 8/10, and 9/27.

TEST 473

Performance of Nematode Wilting Tolerant Selections
Under Nematode Free Condition, Salinas, California, 1973

(10 replications of each variety)

Planted: April 3, 1973
Harvested: September 25, 1973

Variety	Description	Acre Yield Sugar Pounds	Acre Yield Beets Tons	Sucrose Percent	Harvest Count Number
RW 290	Sel. from Netherlands	6,670	22.19	15.1	115
RW 768	Sel. from Netherlands	6,000	21.57	13.9	121
US H10B	Commercial variety	5,670	20.33	14.0	132
RW 610	Sel. from Netherlands	5,430	19.13	14.2	99
Mean		5,940	20.80	14.3	Beets
LSD (.05)		618	NS	0.7	per
Coefficient of Variation (%)		11.34	12.95	5.35	100'
F value		6.33**	NS	5.27**	row

**Exceeds the 1% point of significance (F=4.60)

TEST 573. DIPLOID-TRIPLOID COMPARISON TEST, SALINAS, CALIFORNIA, 1973

10 replications
2 row plots, 53 ft. long

Planted: April 3, 1973
Harvested: September 25, 1973

Variety	Description	Acre Yield		Sucrose	Mildew	Root Rot	Beets/ 100'
		Sugar Pounds	Beets Tons	Percent	Percent	Percent	Number
217H8	F70-546H3 x 813	5,880	19.62	15.1	2.4	0.4	120
217TH8	F70-546H3 x 917T	5,930	19.67	15.1	1.0	1.5	124
217H52	8522H1 x 813	5,890	19.89	14.9	2.0	0.7	117
217TH52	8522H1 x 917T	5,960	19.56	15.3	1.0	2.5	119
217H62	8536H1 x 813	6,050	20.43	14.9	1.8	0.5	122
217TH62	8536H1 x 917T	6,080	20.55	14.8	1.5	1.8	115
252/71	Triploid hybrid from Poland	5,870	18.50	16.0	2.6	1.7	110
Mean		5,950	19.75	15.1	1.8	1.3	118
LSD (.05)		NS	NS	NS	NS	1.0	5.37
Coefficient of Variation (%)		10.2	12.2	6.0	92.3	86.2	5.10
F value		0.20	0.80	1.90	1.52	5.01**	5.71**

**Exceeds the 1% point of significance (F = 3.15).

TEST 673. HYBRID TEST, SALINAS, CALIFORNIA, 1973

10 replications
1 row plots, 53 ft. long

Planted: April 3, 1973
Harvested: October 16, 1973

Variety	Description	Acre Yield		Sucrose	Root Rot	Mildew	Beets/ 100'
		Sugar Pounds	Beets Tons	Percent	Percent	Percent	Number
Y204H79	(9718H0 x 9705) x Y104A,B	7,530	25.10	15.0	0.8	1.0	113
Y222H79	(9718H0 x 9705) x Y022	7,470	24.81	15.0	1.6	1.8	108
Y204H81	(8522H1 x 9718) x Y104A,B	7,450	25.40	14.6	0.7	0.5	109
217H82	(0705H0A x 9718) x 813	7,430	25.49	14.6	1.5	1.2	119
Y101H8	546H3 x Y001A,B	7,400	25.01	14.8	1.1	0.6	91
US H10B	546H3 x F70-17 (1068)	7,380	24.67	14.9	0.3	1.5	118
217H79	(9718H0 x 9705) x 813	7,360	24.81	14.9	1.5	0.5	113
217H78	(8536H1 x 9705) x 813	7,280	24.61	14.8	0.8	1.3	117
217H81	(8522H1 x 9718) x 813	7,220	24.96	14.4	0.3	1.1	114
217H62	(5564H0 x 8536) x 813	7,150	24.59	14.5	0.2	1.4	122
217H80	(F68-564H0 x 9718) x 813	7,150	24.60	14.5	0.6	1.3	116
217H8	F70-546H3 x 813	7,130	24.44	14.6	1.2	0.5	119
U913H8	546H3 x F68-13 (US H9B)	7,090	24.05	14.7	0.2	1.6	111
223-1H8	F70-546H3 x 123-1	7,040	24.04	14.7	0.9	0.5	113
Y204H8	F70-546H3 x Y104A,B	6,960	23.75	14.6	0.7	0.4	114
223-2H8	F70-546H3 x 123-2	6,830	23.66	14.4	0.7	2.0	115
813H8	546H3 x 713A	6,790	23.43	14.5	0.2	1.6	120
Y227H79	(9718H0 x 9705) x Y127	6,700	23.06	14.5	0.3	1.1	112
217H52	(5564H0 x 8522) x 813	6,680	23.78	14.1	0.9	0.6	117
Y227H8	F70-546H3 x Y127	6,640	22.44	14.8	0.5	1.1	113
Y222H8	F70-546H3 x Y022	6,570	22.59	14.6	1.1	1.8	111
664H8	546H3 x 64 (US H7A)	6,550	22.14	14.8	0.3	0.8	114
223-3H8	F70-546H3 x 123-3	6,530	22.75	14.3	0.3	0.8	119
US H10A	569H3 x F70-17 (1231)	6,470	21.91	14.7	1.1	1.1	120
U913H4	569H3 x F68-13 (US H9A)	6,180	21.50	14.4	0.3	2.4	115
Mean		7,000	23.90	14.63	0.7	1.1	114
LSD (.05)		775	2.32	0.45	NS	NS	7.1
Coefficient of Variation (%)		12.6	11.0	3.5	160.2	150.6	7.1
F value		1.9**	1.89**	1.87**	NS	NS	5.4**

**Exceeds the 1% point of significance (F = 1.8).

TEST 773. VARIETY X VIRUS YELLOWS TEST, SALINAS, CALIFORNIA, 1973

7 replications
2 virus treatments
1 row plots, 37 ft. long

Planted: April 4, 1973
Inoculated: July 3, 1973
Harvested: October 3, 4, 1973

Variety	Description	Sugar Yield (lb/A) Check	Inoc.	% Loss	Beet Yield (Tons/A) Check	Inoc.	% Loss
US H10B	546H3 x F70-17 (1068)	8,490	6,840	19.5	27.60	23.02	16.3
Y201	YRS Y001A,B	8,470	6,570	20.7	26.63	21.77	16.4
Y231	BRS Y001A,B	8,070	6,690	17.1	25.83	22.31	13.6
Y204	Inc. Y104A,B	7,930	6,670	15.3	25.91	22.53	12.7
216	Imp. Val. Sel. 916	7,690	6,060	20.5	26.09	20.87	19.2
Y003	Inc. Y803	7,680	7,130	4.5	24.58	23.06	3.8
Y230B	YRS 068/3	7,580	5,720	23.8	25.03	20.49	17.9
2216	BMRS 1238S (13)	7,580	5,800	23.1	25.67	20.33	20.4
Y229/2	YRS 713A (G. S.)	7,560	5,780	22.4	25.10	19.68	20.3
Y207	Inc. Y107 (Y04mm)	7,470	5,730	22.7	24.61	19.81	18.7
F71-17	Inc. F70-17	7,400	5,910	18.4	23.80	20.21	13.4
413C	Inc. 313	7,310	5,180	27.3	24.43	18.40	22.8
217	Inc. 813	7,290	5,500	24.1	23.80	18.64	21.3
F70-13	Inc. F66-13	7,290	5,580	22.9	24.64	19.90	18.3
223-2	Inc. 123-2	7,230	5,480	22.9	24.62	19.18	21.1
Y229/1	YRS 713A (% S.)	7,200	5,990	14.9	22.69	19.86	11.2
223-1	Inc. 123-1	7,190	5,480	24.0	24.56	19.46	20.8
Y230A	YRS 068/2	7,190	5,230	26.6	23.56	18.94	18.7
117T	Inc. 917T	7,180	5,050	28.9	24.59	17.48	28.0
Y232	BRS 813	7,170	5,280	24.8	23.10	18.07	20.3
Y222A	YRS Y022	7,110	6,250	11.2	23.61	21.65	7.5
Y233	BRS Y022	6,990	5,810	16.4	23.44	20.55	11.8
Y229/3	YRS 713A (L. % S.)	6,900	5,420	21.0	23.58	19.64	16.3
Y206	Inc. Y106 (Y01mm)	6,890	5,330	22.5	21.84	18.00	17.9
SP22-0	SP7222-0 from Coe	6,700	4,170	37.7	21.47	14.77	31.2
868	Inc. F57-68	6,680	4,650	28.3	22.60	16.97	23.2
Y238	F_2(SP6822-0(B) x 813)	6,630	6,020	8.6	22.69	20.74	7.7
813 Ore.	Inc. 713A	6,570	5,690	12.5	21.57	19.65	8.3
218	Imp. Val. Salt Sel.	6,520	5,640	10.2	21.09	18.73	8.4
223-3	Inc. 123-3	6,500	4,690	26.5	22.11	17.15	20.8
Y208	Inc. Y108 (13mm)	6,080	4,710	21.4	20.49	16.36	19.6
Y227	Inc. Y127	5,880	4,710	17.7	19.41	16.36	14.4
Mean		7,200	5,649	20.6	23.77	19.52	17.0
LSD (.05)		838	838	14.6	2.61	2.61	NS
Coefficient of Variation (%)		12.0	12.0	67.5	11.1	11.1	81.5
F value		8.5**	8.5**	1.6*	7.87**	7.87**	1.3

* and **Exceeds the 5% (F = 1.46) and 1% (F = 1.70) points of significance.

Significant variety x virus interactions did not occur for any variable.

TEST 773. VARIETY X VIRUS YELLOWS TEST, SALINAS, CALIFORNIA, 1973 (con.)

7 replications
2 virus treatments
1 row plots, 37 ft. long

Planted: April 4, 1973
Inoculated: July 3, 1973
Harvested: October 3, 4, 1973

Variety	Description	% Sucrose			Root Rot	Beets/ 100'
		Check	Inoc.	% Loss	Percent	Number
US H10B	546H3 x F70-17 (1068)	15.4	14.9	3.6	1.4	121
Y201	YRS Y001A,B	16.0	15.1	5.6	0.2	100
Y231	BRS Y001A,B	15.7	15.0	3.8	0.9	112
Y204	Inc. Y104A,B	15.3	14.8	3.1	0.2	100
216	Imp. Val. Sel. 916	14.8	14.6	1.4	1.3	106
Y003	Inc. Y803	15.6	15.5	0.9	0.7	100
Y230B	YRS 068/3	15.1	14.0	7.3	0.0	107
2216	BMRS 1238S (13)	14.8	14.3	3.4	2.2	108
Y229/2	YRS 713A (G. S.)	15.1	14.7	2.6	1.3	107
Y207	Inc. Y107 (Y04mm)	15.2	14.5	4.5	1.4	103
F71-17	Inc. F70-17	15.6	14.7	5.6	0.8	111
413C	Inc. 313	15.0	14.1	5.8	0.8	103
217	Inc. 813	15.3	14.8	3.6	1.7	102
F70-13	Inc. F66-13	14.8	14.0	5.4	0.3	110
223-2	Inc. 123-2	14.7	14.3	2.1	2.1	94
Y229/1	YRS 713A (% S.)	15.8	15.2	4.2	0.6	105
223-1	Inc. 123-1	14.7	14.1	3.9	2.5	92
Y230A	YRS 068/2	15.3	13.9	8.7	0.9	87
117T	Inc. 917T	14.6	14.4	1.1	2.8	99
Y232	BRS 813	15.6	14.7	5.6	0.6	102
Y222A	YRS Y022	15.1	14.4	4.2	2.3	99
Y233	BRS Y022	14.9	14.1	5.2	1.8	102
Y229/3	YRS 713A (L. % S.)	14.7	13.8	5.5	1.9	101
Y206	Inc. Y106 (Y01mm)	15.8	14.9	5.5	0.2	106
SP22-0	SP7222-0 from Coe	15.6	14.1	9.7	0.9	117
868	Inc. F57-68	14.8	13.7	7.4	0.9	114
Y238	F_2(SP6822-0(B) x 813)	14.7	14.6	0.4	1.1	114
813 Ore.	Inc. 713A	15.3	14.5	4.6	1.5	102
218	Imp. Val. Salt Sel.	15.4	15.0	2.4	2.0	110
223-3	Inc. 123-3	14.7	13.7	7.3	1.6	86
Y208	Inc. Y108 (13mm)	14.8	14.4	2.6	0.5	93
Y227	Inc. Y127	15.1	14.4	4.5	2.2	94
Mean		15.2	14.5	4.4	1.2	103
LSD (.05)		0.6	0.6	NS	1.6	8.1
Coefficient of Variation (%)		3.4	3.4	111.6	176.8	10.5
F value		8.4**	8.4**	1.4	1.7**	8.0**

* and **Exceeds the 5% (F = 1.46) and 1% (F = 1.70) points of significance.

Significant variety x virus interactions did not occur for any variable.

TEST 873. HYBRID EVALUATION TEST, SALINAS, CALIFORNIA, 1973

14 replications
1 row plots, 37 ft. long

Planted: April 4, 1973
Harvested: October 1, 2, 1973

Variety	Description	Acre Yield		Sucrose	Root Rot	Beets/ 100'
		Sugar Pounds	Beets Tons	Percent	Percent	Number
217H16	F69-546H5 x 813	7,740	24.72	15.7	0.8	106
217H69	0705H5 x 813	7,680	24.56	15.7	1.7	102
Y204H82	1718H54 x Y104A,B	7,610	23.73	16.0	0.8	107
Y222H69	0705H5 x Y022	7,570	24.09	15.7	1.4	108
2773H82	1718H54 x 1773	7,560	24.04	15.7	0.6	95
Y227H69	0705H5 x Y127	7,500	24.00	15.7	1.5	111
2773H8	F70-546H3 x 1773	7,480	23.80	15.7	0.4	112
US H10B	546H3 x F70-17 (1068)	7,440	24.19	15.4	1.4	114
Y204H83	1724H72mm x Y104A,B	7,390	23.84	15.5	1.5	95
217H83	1724H72mm x 813	7,330	23.84	15.4	1.8	105
217H73	0724H5 x 813	7,300	23.63	15.4	1.8	108
217H75	1724H54 x 813	7,180	22.71	15.8	0.4	107
2755H82	1718H54 x 1755	7,070	22.37	15.8	0.3	107
US H20	SL(129 x 133) x SP6322-0	6,950	21.79	15.9	0.7	117
2791H82	1718H54 x 1792,3,7,8	6,830	21.99	15.5	1.4	109
2755H8	F70-546H3 x 1755	6,590	21.14	15.6	1.4	98
868H4	569H3 x F57-68	6,360	19.95	15.9	0.4	111
2791H8	F70-546H3 x 1792,3,7,8	6,280	20.17	15.6	0.2	106
Mean		7,214	23.03	15.7	1.0	107
LSD (.05)		602	1.84	NS	NS	6.6
Coefficient of Variation (%)		11.2	10.7	3.7	178.7	8.3
F value		4.3**	4.97**	1.3	1.4	6.2**

**Exceeds the 1% point of significance (F = 2.18).

TEST 1073. SUGAR COMPANY HYBRID TEST, SALINAS, CALIFORNIA, 1973

6 replications
1 row plots, 37 ft. long

Planted: April 7, 1973
Harvested: September 28, 1973

Variety	Description	Acre Yield		Sucrose	Root Rot	Beets/ 100'
		Sugar	Beets			
		Pounds	Tons	Percent	Percent	Number
GW-3	72MSH1053	9,370	30.81	15.2	1.2	83
Y204H82	(0705H0A x 9718) x Y104A,B	9,210	30.15	15.3	3.6	81
U & I-1	CMS x 514467	8,910	30.80	14.5	2.4	73
GW-1	GWH58-72R	8,590	26.29	16.4	0.6	88
ACS-3	S-72-400	8,530	27.27	15.6	1.5	79
GW-2	72MSH1047	8,400	29.32	14.4	2.2	74
ACS-1	S-72-320	8,320	25.14	16.6	1.9	81
Spreckels-2	H69561	8,250	27.91	14.8	1.5	87
217H82	(0705H0A x 9718) x 813	8,140	28.04	14.6	1.2	89
Spreckels-1	S101H	8,120	27.14	15.0	0.0	108
Amalgamated-1	2107	8,100	27.38	14.8	4.5	92
ACS-2	S-72-360	8,090	25.27	16.0	3.0	82
Holly-3	Hybrid III	8,050	27.32	14.8	0.4	112
US H20	(129CMS x 133) x SP6822-0	7,960	26.75	14.9	0.9	95
Holly-2	Hybrid II	7,860	25.68	15.3	0.0	111
Spreckels-3	H71415	7,790	26.56	14.7	1.1	93
Amalgamated-3	2138	7,740	24.68	15.7	1.8	104
Holly-1	Hybrid I	7,670	24.44	15.7	0.0	74
U & I-3	CMS x 515069	7,660	24.40	15.7	0.0	82
217H80	(F68-564H0 x 9718) x 813	7,640	26.20	14.6	1.9	89
Amalgamated-2	E1131	7,610	23.65	16.1	0.0	78
US H10B	546H3 x C17	7,550	25.01	15.1	0.0	87
U & I-2	CMS x (C544-1 x CT5A)	7,390	26.14	14.1	0.9	55
US H7A	546H3 x 64	7,180	24.79	14.5	0.0	88
Mean		8,089	26.71	15.2	1.3	87
LSD (.05)		1,192	3.85	0.7	2.7	15.9
Coefficient of Variation (%)		12.9	12.6	4.0	182.7	16.0
F value		1.7*	2.15**	7.1**	1.7*	5.2**

* and **Exceeds the 5% and 1% points of significance (F = 1.61, F = 1.95), respectively.

TEST 1273. YELLOWS EVALUATION OF SELF-FERTILE LINES, SALINAS, CALIFORNIA, 1973

2 virus treatments
12 tests, each with 4 replications
1 row plots, 20 ft. long

Planted: April 25, 1973
Inoculated: July 11, 12, 1973
Harvested: October 29 - 31, 1973

Variety	Description	Sugar Yield (lb/A) Noninoc.	Sugar Yield (lb/A) Inoc.	Beet Yield (T/A) Noninoc.	Beet Yield (T/A) Inoc.	% Sucrose Noninoc.	% Sucrose Inoc.	Beets/ 100' Number
Tests 1 and 7 [1]								
9703	YRS (121 x 8539)	4,840	3,220	16.31	11.49	14.8	14.2	119
7716	YRS (062-3 x B25-9)	5,520	2,600	17.28	9.03	16.0	14.3	105
7716H0	(716H3 x 716) x 716	8,090	4,250	24.42	14.29	16.6	14.9	127
7754	YRS (671-22 x 9716-10)	5,640	2,970	17.23	10.04	16.3	14.6	112
7754H0	(754H4 x 754) x 754	7,220	4,010	22.39	13.32	16.1	15.0	117
7757	YRS (911 x 9716-4)	5,850	4,110	18.82	13.61	15.5	15.2	117
9760	YRS (911 x 9717-4)	6,030	3,580	18.77	11.44	16.0	15.6	122
9760H0	760H4 x 760	8,390	5,500	25.05	17.52	16.8	15.8	123
7734	YRS (927-35 x 5577-2)	8,010	5,140	25.05	17.23	16.0	14.9	116
1729	YRS (Maa x 13,10,21,Y04)	6,780	3,790	20.51	12.16	16.5	15.4	109
1722	YRS (330 x 3563-1)	6,750	4,100	20.46	12.79	16.5	16.0	126
9739	YRS (421 x 4701)	7,220	3,420	22.44	11.29	16.2	15.2	121
9759	YRS ((330 x 234) x 5702)	4,330	3,300	13.56	11.53	16.0	14.3	114
0716	mm sel. 6716A	4,350	2,500	13.95	8.98	15.6	13.9	108
0769	Inc.(6522 x 6705)	4,570	4,490	13.80	14.48	16.6	15.5	125
9711A	Inc.((NBlaa x 234) x 613)	5,280	3,550	16.80	11.97	15.8	14.8	120
7704	YRS (121 x 1716-6)	7,120	5,470	21.14	17.52	16.8	15.6	129
F70-546H3	562H0 x 546	5,310	4,060	16.02	13.18	16.5	15.5	117
Mean		6,183	3,892	19.11	12.88	16.1	15.0	118
LSD (.05)		1,256	1,729	4.16	NS	0.8	0.7	--
Coefficient of Variation (%)		14.3	31.3	15.3	30.8	3.4	3.3	--
F value		8.8**	2.1*	6.68**	1.72	3.4**	5.9**	--
Tests 2 and 8								
0705	YRS (121 x 2743)	6,620	4,640	19.40	14.86	17.1	15.6	127
2705	BRS 0705	5,780	3,820	16.89	12.31	17.1	15.6	129
2705H0	BRS 0705H0 x BRS 0705	7,210	4,730	20.32	14.72	17.7	16.1	137

TEST 1273. YELLOWS EVALUATION OF SELF-FERTILE LINES, SALINAS, CALIFORNIA, 1973 continued

Variety	Description	Sugar Yield (lb/A)		Beet Yield (T/A)		% Sucrose		Beets/ 100'
		Noninoc.	Inoc.	Noninoc.	Inoc.	Noninoc.	Inoc.	Number
F71-705	Inc. C0705	5,600	3,070	16.51	10.14	17.0	15.2	129
F71-705HO	C0705HO x C0705	6,630	5,480	19.55	17.23	17.0	16.0	139
1705A	YRS 9705	5,100	3,950	14.82	12.31	17.3	16.0	129
1707	YRS (121 x 2546-22-35)	6,160	2,970	18.29	9.27	16.8	16.0	140
1714	YRS (2563 x 2743)	6,840	4,000	20.80	13.18	16.4	15.2	121
9714HO	714H30 x 7714	7,220	4,460	20.90	13.90	17.3	16.1	138
2718	YRS (2563 x 1716-6)	6,030	2,560	18.92	8.98	15.9	14.5	126
2718HO	7718H32 x 718[3]	6,680	4,710	20.70	16.99	16.1	13.9	135
1718	YRS (2563 x 1761-6)	6,470	2,750	19.55	9.27	16.5	14.9	132
1718HO	(7718H32 x 718) x 718	8,020	4,210	24.71	14.14	16.2	15.0	142
1724	YRS (321 x 2764)	4,650	2,880	14.19	9.36	16.4	15.3	111
1724HO	(9724H49 x 724) x 724	7,380	5,830	21.81	18.68	16.9	15.6	130
2774	mm sel. (712aa x 705,...)	5,600	3,710	16.80	12.45	16.7	14.8	128
1565	Inc. C9564	4,520	2,480	13.85	8.69	16.3	14.2	136
1565HO	F68-564HO x C9564	5,550	3,050	16.99	10.52	16.3	14.5	133
Mean		6,226	3,851	18.61	12.61	16.7	15.2	131
LSD (.05)		907	1,262	2.52	4.07	0.6	0.7	--
Coefficient of Variation (%)		10.3	23.1	9.6	22.8	2.6	3.2	--
F value		9.0**	5.1**	10.21**	4.67**	4.7**	7.8**	--
Tests 3 and 9								
2708	YRS (Maa x 705,...)mm	5,380	3,370	15.78	10.67	17.0	15.8	123
2709	YRS (mmaa x 760,...)mm	6,200	3,000	18.53	10.04	16.7	14.9	122
2710	YRS (711,12aa x 601,...)mm	5,960	3,270	18.24	10.33	16.3	15.7	122
2713	YRS (723aa x 601,...)mm	5,810	3,090	17.23	10.04	16.8	15.4	122
2730	YRS (13 x 522,...)mm	5,990	3,510	18.24	11.92	16.4	14.7	135
2731	YRS (Y04 x 522,...)mm	5,640	3,590	16.31	11.49	17.2	15.6	127
2733	YRS (Y01,10,44 x 564,...)mm	5,800	4,070	16.60	12.74	17.5	16.0	128
2736	YRS (Maa x 601,...)mm	5,020	2,130	14.24	6.95	17.6	15.3	124
2737	YRS (Maa x 823,...)mm	5,270	3,110	15.44	10.42	17.1	14.9	138

TEST 1273. YELLOWS EVALUATION OF SELF-FERTILE LINES, SALINAS, CALIFORNIA, 1973 continued

Variety	Description	Sugar Yield (lb/A) Noninoc.	Sugar Yield (lb/A) Inoc.	Beet Yield (T/A) Noninoc.	Beet Yield (T/A) Inoc.	% Sucrose Noninoc.	% Sucrose Inoc.	Beets/ 100' Number
2778	YRS (13 x 705)mm	4,880	3,290	13.85	10.23	17.6	16.1	124
2779	YRS (13 x 718)mm	3,790	3,300	11.25	10.18	16.9	16.1	127
2780	YRS (13 x 724)mm	5,830	3,410	18.39	11.82	15.9	14.5	120
2781	YRS (10 x 705)mm	4,490	3,380	13.90	11.25	16.2	15.1	123
2783	YRS (10 x 701,764)mm	6,660	4,980	20.61	15.78	16.2	15.8	126
2784	YRS (44 x 705)mm	5,620	3,170	16.75	10.42	16.8	15.2	126
2786	YRS (44 x 701,764)mm	7,260	5,600	21.19	16.65	17.1	16.8	131
2787,8	YRS (60,61 x 716,...)mm	5,180	2,670	16.17	8.88	16.1	15.1	117
F68-564HO	F67-564HO x F67-564	6,010	3,000	18.53	10.23	16.2	14.7	135
Mean		5,599	3,442	16.74	11.11	16.8	15.4	126
LSD (.05)		849	1,189	2.45	3.74	0.7	0.7	--
Coefficient of Variation (%)		10.7	24.3	10.3	23.7	3.0	3.0	--
F value		6.9**	3.5**	8.27**	2.90**	4.8**	6.9**	--
Tests 4 and 10								
2758-1	YRS (7522 x 7705)	6,410	3,700	19.55	12.11	16.4	15.3	129
2758-3	YRS (7536 x 7705)	6,080	4,560	17.91	14.38	17.0	15.9	120
2758-4	YRS (8536 x 7724)	7,020	5,070	21.04	16.94	16.7	15.0	116
0761-1	S_1(13 x 7522)	7,880	5,360	25.97	18.20	15.2	14.8	125
0761-2	S_1(13 x 7534)	6,790	4,890	20.13	15.88	16.9	15.4	127
0761-3	S_1(13 x 8536)	7,710	4,510	24.03	14.91	16.1	15.1	129
0761-6	S_1(13 x 7564)	6,950	5,200	20.75	16.60	16.8	15.7	120
0762-1	S_1(Y04 x 7522)	8,750	5,710	27.36	18.53	16.0	15.4	121
0762-2	S_1(Y04 x 7534)	7,050	4,060	21.14	13.13	16.7	15.5	111
0762-3	S_1(Y04 x 7536)	7,310	4,390	21.53	14.04	17.0	15.6	116
0762-5	S_1(Y04 x 7564)	7,510	5,500	22.68	17.86	16.6	15.4	118
0763-1,2,3,4	S_1(Y01 x 564,...)	7,410	6,120	22.44	18.97	16.5	16.2	105
0763-5	S_1(10 x 6563)	8,850	5,360	27.36	18.29	16.2	14.6	114
0763-6,7,8	S_1(44 x 823,...)	7,140	6,780	22.15	22.39	16.1	15.1	117
0765	S_1(522,... x 7760)	7,060	5,090	21.96	17.13	16.1	15.0	123

TEST 1273. YELLOWS EVALUATION OF SELF-FERTILE LINES, SALINAS, CALIFORNIA, 1973 continued

Variety	Description	Sugar Yield (lb/A)		Beet Yield (T/A)		% Sucrose		Beets/ 100'
		Noninoc.	Inoc.	Noninoc.	Inoc.	Noninoc.	Inoc.	Number
0766	S_1(534,... x 7757)	7,220	5,190	22.15	17.37	16.3	15.0	121
0767	S_1(534,... x 7734)	6,710	5,500	20.46	17.76	16.4	15.5	110
0768	S_1(532,... x 7716)	6,330	4,100	19.40	13.51	16.3	15.2	116
Mean		7,232	5,061	22.11	16.56	16.4	15.3	119
LSD (.05)		1,211	1,438	3.55	4.69	0.8	NS	--
Coefficient of Variation (%)		11.8	20.0	11.3	20.0	3.3	3.9	--
F value		3.0**	2.3*	4.38**	2.34**	2.5**	1.6	--
Tests 5 and 11								
2775	(0792aa x 700mm)mm	8,040	5,600	23.12	17.81	17.4	15.7	129
2776	(0793aa x 700mm)mm	7,590	6,080	22.25	18.10	17.0	16.8	135
2777	(0797aa x 700mm)mm	7,750	5,150	22.49	16.70	17.2	15.4	134
2792	(mmaa x 760,...)mm	7,130	4,910	20.61	15.69	17.3	15.7	119
2793	(Maa x 705,...)mm	6,390	4,170	18.53	13.51	17.3	15.4	121
2794	(Maa x 601,...)mm	6,150	3,750	18.48	12.60	16.7	15.0	127
2795	(Maa x 823,...)mm	6,760	3,920	19.31	12.50	17.5	15.7	126
2797	(711,12aa x 522,...)mm	7,060	5,060	21.86	16.31	16.2	15.5	134
2798	(mmaa x 13)mm	7,460	5,520	22.68	18.24	16.5	15.2	128
F70-546	Inc. F63-546	7,470	5,400	21.72	17.33	17.2	15.6	137
1522-25	Inc. 8522-25, 25A,25-1,...	5,690	3,000	19.55	12.60	14.6	11.8	121
1536-21	Inc. 8536-21C2	4,880	3,160	15.73	11.49	15.5	13.8	127
1536-35	Inc. 8536-35	4,650	2,760	14.91	9.75	15.6	14.1	124
1536HO	8536H1 x 8536	6,980	5,080	21.14	17.04	16.5	14.9	143
1502 (Sp.)	Inc. 0502	6,030	3,920	18.15	12.36	16.6	16.0	108
1502HO (Sp.)	0502HO x 0502	6,670	4,540	19.84	14.96	16.8	15.2	112
8511	Inc. F56-511	7,350	5,510	21.67	17.76	17.0	15.6	118
2554 (Sp.)	Inc. 0554	7,020	5,050	20.99	16.41	16.8	15.3	131
Mean		6,726	4,588	20.17	15.06	16.6	15.1	126
LSD (.05)		1,115	1,025	3.07	3.32	0.8	1.1	--
Coefficient of Variation (%)		11.7	15.7	10.7	15.5	3.5	4.9	--
F value		5.8**	7.4**	4.63**	5.14**	6.9**	8.1**	--

TEST 1273. YELLOWS EVALUATION OF SELF-FERTILE LINES, SALINAS, CALIFORNIA, 1973 continued

Variety	Description	Sugar Yield (lb/A)		Beet Yield (T/A)		% Sucrose		Beets/ 100'
		Noninoc.	Inoc.	Noninoc.	Inoc.	Noninoc.	Inoc.	Number
Tests 6 and 12								
2755Ma	Inc.(mmaa x 704,...)	8,930	6,100	27.70	20.51	16.2	14.9	116
2770Ba	YRS (711aa x 735,...)	6,970	5,780	20.90	18.97	16.7	15.2	121
2771Ba	YRS (711aa x 724,...)	8,930	8,020	27.61	25.34	16.2	15.8	124
2773a	Inc.(711,12aa x 753,...)	8,420	7,760	26.54	25.05	15.9	15.5	119
2773Ba	YRS (711,12aa x 753,...)	8,380	7,830	25.48	24.42	16.5	16.0	127
2774Ba	YRS (712aa x 705,...)	8,270	8,120	24.81	25.19	16.7	16.1	118
2791Ma	Inc.(aa x 1792,3,7,8)	8,310	5,710	25.92	18.44	16.1	15.4	114
1792Ma	Inc.(mmaa x 760,...)	7,900	5,890	24.42	19.06	16.2	15.5	109
1793Ma	Inc.(Maa x 705,...)	8,170	6,060	24.71	19.16	16.6	15.8	111
1794Ma	Inc.(Maa x 601,...)	6,830	4,800	20.75	16.22	16.5	14.8	127
1795MA	Inc.(Maa x 823,...)	6,530	3,760	19.35	12.36	16.9	15.2	101
1796a	Inc.(Maa x 13,...)	8,220	7,370	24.47	23.55	16.8	15.6	128
1797Ma	Inc.(711,12aa x 522,...)	8,170	5,910	25.53	19.50	16.0	15.2	120
1798Ma	Inc.(mmaa x 13)	8,140	6,650	24.66	21.38	16.6	15.6	124
1230	0792aa x 700mm	8,430	7,630	25.34	24.66	16.7	15.5	117
1231	0793aa x 700mm	8,260	7,440	24.71	23.65	16.8	15.8	133
1232	0797aa x 700mm	8,830	7,950	26.74	25.14	16.6	15.8	126
2554H1	0502H0 x 0554	8,490	6,260	26.01	20.51	16.3	15.2	122
Mean		8,124	6,614	24.76	21.28	16.4	15.5	120
LSD (.05)		1,027	1,044	3.40	3.21	NS	NS	--
Coefficient of Variation (%)		8.9	11.1	9.7	10.6	3.7	3.6	--
F value		3.5**	11.2**	3.63**	10.35**	1.0	1.7	--

* and **Exceeds the 5% (F = 1.8) and 1% (F = 2.3) points of significance, respectively.

1/ Each pair of tests, e.g., 1 and 7, were duplicate tests grown contiguously. Tests 1-6 were not inoculated and tests 7-12 were inoculated with BYV-BWYV.

VARIETY TRIALS, BRAWLEY, CALIFORNIA, 1972-73

Location: U.S. Department of Agriculture, Imperial Valley Conservation Research Center.

Soil type: Holtville silty clay loam.

Previous crops: Barley, 1970-71 and 1971-72.

Fertilizers used: Preplant: 250 lbs/A 11:48:0 and 220 lbs/A urea (46% N) broadcast and disced in before listing. Sidedressing: 92 lbs/A actual N, as urea, on December 6, 1972. A total of 220 lbs/A of N was applied to 1972-73 test plots.

Planting date: September 14-16, 1972.

Thinning date: October 5, 1972.

Harvest dates: Early harvests - Tests 1, 2 and 3, May 1-4, 1973.
Late harvest - Test 4, June 27-29, 1973.

Irrigations: Early harvests - seven by furrow plus 2.75" rainfall in late January, 1973.
Late harvest - nine by furrow.

Diseases and insects: Yellows infection was moderate during 1973. Curly top infection was minor. Infestations of desert flea beetle, striped cucumber beetle and beet armyworm were controlled with spray applications of 6 oz Lannate plus 6 oz EMP, on September 21 and 29, 1972. Aphid buildups were controlled with applications of 10% Thimet granules.

Experimental design: All yield trials were of randomized block design with 10 replications each. Tests 1 and 4 had 15 and 17 entries, respectively, and were sown in two-row plots. Tests 2 and 3 had 16 and 12 entries, respectively, both sown in single-row plots. Plots were 40' long with rows spaced 30" apart.

Sugar analysis: From two ten-beet samples per plot for all trials by Holly Sugar Corporation, Brawley, California.

Remarks: Test designed and data analyzed by the U.S. Agricultural Research Station, Salinas, California. After stands were established, the test plot was under supervision of J. Robertson and A. J. MacKenzie, United States Department of Agriculture, Imperial Valley Conservation Research Center, Brawley, California.

VARIETY TEST, BRAWLEY, CALIFORNIA, 1973

(10 replications of each variety)
(Two-row plots)

Planted: September 14, 1972
Harvested: May 1, 1973

Variety	Description	Acre Yield		Sucrose	Bolting	Harvest Count
		Sugar	Beets			
		Pounds	Tons	Percent	Percent	Number
217H52	8522H1 x 813	10,270	31.12	16.5	0.0	117
217H80	1718H5 x 813	10,250	31.41	16.3	1.8	121
217H82	1718H54 x 813	10,210	31.23	16.3	2.6	110
217H8	F70-546H3 x 813	10,160	31.16	16.3	1.8	122
U913H8	US H9B	9,850	29.95	16.5	1.9	121
217H62	8536H1 x 813	9,830	30.03	16.4	1.9	121
U913H4	US H9A	9,820	30.12	16.3	2.0	125
Y204H82	1718H54 x Y104A,B	9,810	30.02	16.4	5.8	114
217TH52	8522H1 x 917T	9,790	30.87	15.9	1.0	118
217TH8	F70-546H3 x 917T	9,730	30.26	16.1	2.6	112
217TH62	8536H1 x 917T	9,670	30.16	16.1	2.2	98
117H8	US H10B	9,620	28.91	16.7	1.8	138
117H4	US H10A	9,400	29.81	16.4	2.0	143
Y204H8	F70-546H3 x Y104A,B	9,360	28.04	16.7	2.8	120
664H8	US H7A	8,310	24.69	16.8	0.7	127
Mean		9,740	29.85	16.4	2.1	Beets
LSD (.05)		567	1.77	0.37	---	per
Coefficient of Variation (%)		6.58	6.70	2.54	---	100'
F value		4.77**	7.14**	3.47**	---	row

**Exceeds the 1% point of significance (F=2.23).

VARIETY TEST, BRAWLEY, CALIFORNIA, 1973

(10 replications of each variety)
(Single-row plots)

Planted: September 14, 1972
Harvested: May 3, 1973

Variety	Description	Acre Yield		Sucrose	Bolting	Harvest Count
		Sugar	Beets			
		Pounds	Tons	Percent	Percent	Number
217H81	1718H52 x 813	10,720	31.20	17.2	2.6	125
217H79	1705H72mm x 813	10,080	29.72	17.0	6.4	122
Y204H81	1718H52 x Y104A,B	10,050	29.35	17.1	4.1	130
Y204H79	1705H72mm x Y104A,B	10,030	29.58	17.0	14.4	123
117H45	7718H31 x 813	9,940	29.25	17.0	2.3	123
117H8	US H10B	9,840	28.32	17.4	2.5	141
223-1H8	F70-546H3 x 123-1	9,740	28.09	17.4	2.4	132
Y227H8	F70-546H3 x Y127	9,690	28.30	17.1	0.0	133
Y101H8	F70-546H3 x Y001A,B	9,630	27.70	17.4	6.0	109
223-2H8	F70-546H3 x 123-2	9,550	27.49	17.4	2.0	117
223-3H8	F70-546H3 x 123-3	9,430	27.76	17.0	3.7	127
Y222H8	F70-546H3 x Y022	9,390	27.07	17.4	1.4	119
2773H82	1718H54 x 1773	8,540	25.22	16.9	5.5	115
2773H8	F70-546H3 x 1773	8,390	24.14	17.4	5.5	131
2755H8	F70-546H3 x 1755	7,850	22.45	17.5	1.3	119
2791H8	F70-546H3 x 1791	7,390	20.88	17.7	2.4	128
Mean		9,390	27.28	17.2	3.9	Beets
LSD (.05)		674	2.00	0.3	---	per
Coefficient of Variation (%)		8.12	8.30	1.94	---	100'
F value		13.06**	15.12**	4.64**	---	row

**Exceeds the 1% point of significance (F=2.19).

VARIETY TEST, BRAWLEY, CALIFORNIA, 1973

(10 replications of each variety)
(Single-row plots)

Planted: September 14, 1972
Harvested: May 4, 1973

Variety	Description	Acre Yield		Sucrose	Bolting	Harvest Count
		Sugar	Beets			
		Pounds	Tons	Percent	Percent	Number
216	Early Maturity sel. 813	10,530	32.99	16.0	5.7	127
117H8	USH10B	10,480	31.80	16.5	2.9	150
Y201	YRS Y001A,B	10,270	31.19	16.5	13.7	124
F70-13	Inc. F66-413	9,950	31.78	15.7	17.7	132
Y222A	YRS Y022	9,310	29.41	15.9	24.1	127
Y234,5	F_2(FC701,2/2 x 713A)	9,220	28.99	15.9	32.3	135
F71-17	Inc. F70-17 (C17)	9,200	28.97	15.9	11.9	134
2773a	1773aa x 1773A	8,570	27.01	16.0	8.3	127
117T	Tetra 813	8,370	26.80	15.6	4.7	102
2755Ma	1755aa x 1755A	8,190	24.64	16.7	5.4	128
Y227	Inc. Y127	8,070	25.54	15.9	1.2	127
2791Ma	1792,3,7,8aa x A	7,850	24.22	16.3	5.5	128
Mean		9,170	28.61	16.1	11.1	Beets
LSD (.05)		761	2.87	0.57	6.03	per
Coefficient of Variation (%)		9.35	11.29	4.02	61.14	100'
F value		12.74**	8.43**	2.80**	19.21**	row

**Exceeds the 1% point of significance (F=2.43).

VARIETY TEST, BRAWLEY, CALIFORNIA, 1973

(10 replications of each variety)
(Two-row plots)

Planted: September 14, 1972
Harvested: June 27-29, 1973

Variety	Description	Acre Yield Sugar	Acre Yield Beets	Sucrose	Bolting	Root Rot	Harvest Count
		Pounds	Tons	Percent	Percent	Percent	Number
217H80	1718H5 x 813	14,330	43.79	16.4	6.2	10.3	132
Y204H8	F70-546H3 x Y104A,B	14,100	41.77	16.9	12.5	2.9	133
217H82	1718H54 x 813	13,880	42.05	16.5	15.0	5.9	128
217H8	F70-546H3 x 813	13,440	41.05	16.4	7.6	2.7	136
223-3H8	F70-546H3 x 123-3	13,340	40.61	16.5	7.8	3.1	133
Y204H82	1718H54 x Y104A,B	13,320	40.44	16.5	24.5	3.8	125
217TH8	F70-546H3 x 917T	13,280	40.70	16.3	6.7	6.9	125
217H52	8522H1 x 813	13,240	40.88	16.2	5.3	4.2	131
Y222H8	F70-546H3 x Y022	13,210	39.63	16.7	6.8	2.9	127
117H4	USH10A	13,030	39.90	16.3	4.4	4.9	146
Y227H8	F70-546H3 x Y127	12,850	39.67	16.2	4.0	2.5	134
217TH62	8536H1 x 917T	12,830	40.70	15.8	5.7	12.7	118
U913H8	USH9B	12,740	39.05	16.3	7.1	3.2	133
U913H4	USH9A	12,440	38.58	16.1	5.3	4.5	129
217TH52	8522H1 x 917T	12,440	38.47	16.2	5.1	11.1	129
217H62	8536H1 x 813	12,230	37.72	16.2	8.7	8.2	132
664H8	USH7A	11,260	33.83	16.6	2.5	1.5	141
Mean		13,060	39.93	16.4	8.0	5.4	Beets
LSD (.05)		875	2.78	0.46	3.11	2.48	per
Coefficient of Variation (%)		7.62	7.88	3.20	44.18	52.24	100'
F value		5.46**	4.67**	2.14**	22.05**	14.13**	row

**Exceeds the 1% point of significance (F=2.12).

VARIETY TEST, IMPERIAL VALLEY, CALIFORNIA, 1973
By Holly Sugar Corporation

(Data extracted from test of 24 varieties)
14 replications, 1 row plots
25 ft. long, 32 in. between rows

Planted: September 12, 1972
Harvested: June 14, 1973

Variety	Description	Ext. Sugar/A Pounds	Ext. Sugar/T Pounds	Gross Sugar/A Pounds	Beets/A Tons	Sucrose Percent	Bolting Percent	Beets/ 100' Number
US H10A	Lot 1043	5,182	178.2	7,700	29.0	13.25	0.4	134
217H80	1718H5 x 813	5,104	175.4	7,647	29.2	13.12	0.2	138
US H10B	Lot 1027A	4,795	177.7	7,129	26.9	13.22	1.5	136
Y204H8	F70-546H3 x Y104	4,778	182.4	7,035	26.2	13.42	4.3	132
217H52	8522H1 x 813	4,759	177.9	7,080	26.8	13.22	0.8	141
Y204H82	1718H54 x Y104	4,727	177.5	7,032	26.6	13.21	8.4	138
Y227H8	F70-546H3 x Y127	4,724	178.9	7,014	26.5	13.27	0.2	134
217H82	1718H54 x 813	4,647	173.3	6,992	26.8	13.04	2.6	136
US H9B	Lot 1204	4,618	180.6	6,810	25.5	13.34	1.4	138
US H9A	Lot 1028	4,542	175.3	6,793	25.9	13.11	0.8	144
217H62	8536H1 x 813	4,438	170.5	6,714	26.0	12.91	0.4	130
223-3H8	F70-546H3 x 123-3	4,428	174.3	6,645	25.4	13.07	0.2	137
Test Mean		4,684	179.7	6,940	26.1	13.30	6.2	134
LSD (.05)		423	9.2	553	1.9	0.39	--	--
Coefficient of Variation (%)		12	6.9	11	9.9	3.99	--	--
Standard Error of the Mean		152	3.3	199	0.7	0.14	--	--
F value		5.38**	2.79**	6.94**	8.89**	2.78**	--	--

VARIETY TEST, SOUTH SAN JOAQUIN, CALIFORNIA, 1973
By Holly Sugar Corporation

(Data extracted from test of 20 varieties)
9 replications, 1 row plots
25 ft. long, 30 in. between rows

Planted: February 9, 1973
Harvested: August 8, 1973

Variety	Description	Ext. Sugar/A	Ext. Sugar/T	Gross Sugar/A	Beets/A	Sucrose	Beets/ 100'
		Pounds	Pounds	Pounds	Tons	Percent	Number
US H10A	569H3 x C817	4,985	256.1	5,987	19.4	15.40	176
217H62	8536H1 x 813	4,910	272.3	5,751	18.0	15.97	156
217H79M	1705H72M x 813	4,800	248.4	5,862	19.4	15.13	160
223-1H16	F69-546H5 x 123-1	4,703	258.0	5,652	18.3	15.46	167
Y204H81	1718H52 x Y104	4,684	241.0	5,750	19.3	14.81	164
US H9A	569H3 x C413	4,585	268.6	5,421	17.2	15.84	164
Y204H8	F70-546H3 x Y104	4,480	274.8	5,233	16.3	16.06	160
223-3H16	F69-546H5 x 123-1	4,479	251.6	5,433	17.9	15.23	172
217H52	8522H1 x 813	4,296	236.2	5,347	18.2	14.69	165
US H10B	546H3 x C817	4,203	260.6	5,029	16.2	15.56	165
217H82	1718H54 x 813	4,202	261.5	5,027	16.2	15.59	167
217H80	1718H5 x 813	4,195	258.7	5,021	16.2	15.49	169
US H9B	546H3 x C413	4,096	252.9	4,965	16.3	15.27	165
Y227H79	1705H72 x 127-1	4,066	250.3	4,944	16.3	15.19	145
Test Mean		4,618	255.9	5,560	18.1	15.39	--
LSD (.05)		NS	19.5	935	3.0	0.71	--
Coefficient of Variation (%)		19	8.2	18	17.6	4.93	--
Standard Error of the Mean		291	7.0	335	1.1	0.25	--
F value		NS	1.96*	1.75*	2.02*	1.90*	--

VARIETY TEST, TRACY, CALIFORNIA, 1973
By Holly Sugar Corporation

(Data extracted from test of 20 varieties)
9 replications, 1 row plots
25 ft. long, 30 in. between rows

Planted: May 18, 1973
Harvested: October 19, 1973

Variety	Description	Ext. Sugar/A	Ext. Sugar/T	Gross Sugar/A	Beets/A	Sucrose	Beets/ 100'
		Pounds	Pounds	Pounds	Tons	Percent	Number
217H82	1718H54 x 813	3,034	176.2	4,246	17.3	12.31	115
Y204H81	1718H52 x Y104	2,797	183.7	3,868	15.4	12.63	114
Y204H8	F70-546H3 x Y104	2,736	169.3	3,918	16.5	12.02	95
US H10B	546H3 x C817	2,676	171.2	3,797	15.8	12.09	119
US H10A	569H3 x C817	2,551	183.8	3,523	14.0	12.64	108
217H79M	1705H72M x 813	2,512	175.6	3,535	14.5	12.29	107
217H52	8522H1 x 813	2,490	187.2	3,426	13.6	12.76	110
223-1H16	F69-546H5 x 123-1	2,479	171.8	3,536	14.8	12.12	118
217H80	1718H5 x 813	2,430	189.2	3,336	13.2	12.86	109
US H9A	569H3 x C413	2,418	170.8	3,413	14.1	12.08	114
Y227H79	1705H72 x 127-1	2,312	165.2	3,318	14.1	11.83	100
US H9B	546H3 x C413	2,261	170.6	3,224	13.6	12.06	125
223-3H16	F69-546H5 x 123-1	2,159	166.4	3,101	13.1	11.90	118
217H62	8536H1 x 813	2,151	181.8	2,974	11.9	12.54	111
Test Mean		2,413	175.8	3,395	13.9	12.29	112
LSD (.05)		442	13.7	604	2.5	0.58	--
Coefficient of Variation (%)		20	8.3	19	19.2	5.09	--
Standard Error of the Mean		158	4.9	216	0.9	0.21	--
F value		3.62**	2.74**	3.82**	4.04**	2.72**	--

DATA ON U.S.D.A. VARIETIES TESTED BY SPRECKELS SUGAR

Test Areas:	Mendota, Calif.			Woodland, Calif.		
Variety	Sugar T/Ac.	Beets T/Ac.	% Sugar	Sugar T/Ac.	Beets T/Ac.	% Sugar
217H52	5.058	31.44	16.1			
217H62	5.080	31.49	16.2			
217H80	4.752	29.56	16.1			
217H82	5.092	31.41	16.2			
Y204H8	4.899	30.12	16.3			
Y204H81	4.522	27.48	16.5			
117H52				2.486	22.28	11.2
117H62				2.772	24.68	11.3
117H69				2.505	21.59	11.6
117H75				2.627	22.25	11.8
Y101H8				4.075	34.08	11.9
US H9B				4.094	35.59	11.5
GENERAL MEAN	5.015	30.59	16.4	3.809	32.57	11.7
LSD @ P = .05	NS	NS	NS	0.486	4.017	NS
= .01	NS	NS	NS	0.614	5.14	NS
SE of Mean	0.212	1.315	0.286	0.186	1.554	0.203
SE in % of Mean	4.24	4.30	1.74	4.87	4.77	1.74
# Var. in Test:		16			16	
Planting date:	April 4, 1973			May 2, 1972		
Harvest date:	Sept. 21, 1973			Dec. 8, 1972		

VARIETY TEST, DIXON, CALIFORNIA, SPRING HARVEST, 1973
By American Crystal Sugar Company
22407

6 replications, Equalized Random Block Design
2 row plots, 70 ft. long, 30 in. rows

Planted: April 15, 1972
Harvested: March 20-30, 1973

Variety	Description	Acre Yield Gross Sugar Pounds	Acre Yield Recov. Sugar Pounds	Beets Tons	Sucrose Percent	Recov. Sugar/Ton Pounds	Amino N PPM	Na PPM	K PPM	Impurity Index
117H52	8522H1 x C17	18,410	16,060	75.14	12.30	215	310	847	1,855	855
Y004H12B	F68-546H4 x Y904B	18,200	15,380	77.80	11.65	197	416	999	1,934	1,053
117H69	0705H5 x C17	17,690	15,370	70.60	12.69	221	385	856	1,802	889
Y101H8	546H3 x Y001A,B	17,210	14,790	71.72	12.01	206	387	1,005	1,725	954
117H16	F68-546H5 x C17	17,190	14,590	76.54	11.33	193	316	1,033	1,886	1,012
US H10A	569H3 x C17	17,140	14,620	73.59	11.60	198	375	980	1,833	986
Y101H69	0705H5 x Y001A,B	16,850	14,240	76.11	11.05	187	335	964	2,030	1,062
110H69	0705H5 x 910	16,830	14,280	71.02	11.80	200	405	959	2,028	1,032
117H62	8536H1 x C17	16,770	14,560	75.05	11.12	193	243	950	1,704	890
US H10B	546H3 x C17	16,770	14,330	71.82	11.64	199	347	1,014	1,884	1,009
Y004H12	F68-546H4 x Y904A	16,680	14,190	70.18	11.99	204	408	939	1,948	990
117H73	0724H5 x C17	15,220	12,940	67.99	11.26	192	340	997	1,819	997
Mean		17,080	14,610	73.13	11.70	200	356	962	1,871	977
LSD (.05)		NS	NS	NS	NS	NS	NS	NS	NS	NS
Coefficient of Variation (%)		13.18	14.76	9.74	11.20	13.43	27.8	18.4	14.4	17.7
F value		0.79	0.78	1.07	0.84	0.81	1.57	0.66	0.90	0.91

VARIETY TEST, DIXON, CALIFORNIA, SPRING HARVEST, 1973
By American Crystal Sugar Company
22408

6 replications, Equalized Random Block Design
2 row plots, 70 ft. long, 30 in. rows

Planted: April 15, 1972
Harvested: March 20-30, 1973

Variety	Acre Yield			Sucrose	Recov.	Amino			Impurity
	Gross Sugar	Recov. Sugar	Beets		Sugar/Ton	N	Na	K	Index
	Pounds	Pounds	Tons	Percent	Pounds	PPM	PPM	PPM	
US H10B	19,260	16,630	75.54	12.76	220	372	779	2,223	920
HH22	19,250	16,510	78.45	12.31	212	325	812	2,255	939
F66-569H3 x 67-436	18,890	16,070	76.05	12.45	212	366	842	2,395	1,003
68-313 x 65-202B	18,700	15,510	78.13	12.01	199	486	971	2,325	1,155
68-314 x C413	17,990	15,150	73.54	12.29	207	453	839	2,424	1,094
68-313 x 64-208	17,960	15,310	71.08	12.70	217	437	848	2,188	989
US H9B	17,870	14,940	74.34	12.07	202	468	884	2,295	1,125
HH23	17,830	14,880	73.87	12.04	201	420	857	2,623	1,141
68-313 x 813T	17,750	14,680	74.97	12.01	200	460	887	2,487	1,163
(562H0 x 546) x 67-436	17,620	14,980	69.50	12.55	212	446	901	2,274	1,062
63(5H0 x 6) x 65-202B	17,350	14,380	73.11	11.95	199	464	954	2,344	1,138
68-313 x C413	16,830	14,080	71.23	11.79	197	398	949	2,410	1,152
Mean	18,110	15,260	74.15	12.24	207	425	877	2,354	1,073
LSD (.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. (%)	12.11	13.52	10.71	9.24	11.60	21.6	22.1	11.4	16.8
F value	0.72	0.90	0.71	0.46	0.65	1.73	0.56	1.26	1.45

VARIETY TEST, CLARKSBURG, CALIFORNIA, FALL HARVEST, 1973
By American Crystal Sugar Company
32401

6 replications, Randomized Block Design
2 row plots, 35 ft. long, 30 in. rows

Planted: March 25, 1973
Harvested: September 10, 1973

Variety	Description	Acre Yield: Gross Sugar	Acre Yield: Recov. Sugar	Beets	Sucrose	Recov. Sugar/Ton	Amino N	Na	K	Impurity Index
		Pounds	Pounds	Tons	Percent	Pounds	PPM	PPM	PPM	
217H81	1718H52 x 813	10,280	9,240	34.30	14.93	269	435	507	1,680	662
217H52	8522H1 x 813	9,940	9,050	33.11	15.03	274	390	472	1,517	596
217H62	8536H1 x 813	9,810	8,910	32.43	15.15	275	427	500	1,485	616
Y204H8	F70-546H3 x Y104	9,750	8,680	33.91	14.42	257	434	592	1,764	719
US H10B	546H3 x C17	9,520	8,610	31.97	14.80	268	386	656	1,422	629
Y222H8	F70-546H3 x Y022	9,470	8,500	32.34	14.65	263	409	608	1,632	679
217H82	1718H54 x 813	9,450	8,490	32.58	14.58	262	395	558	1,685	668
Y204H79M	1705H72M x Y104A,B	9,430	8,420	32.87	14.40	257	381	660	1,775	711
217H79M	1705H72M x 813	9,410	8,460	32.29	14.64	264	396	551	1,717	668
Y227H8	F70-546H3 x Y127	9,050	8,230	29.43	15.32	279	377	578	1,539	605
217H16	F69-546H5 x 813	8,830	7,970	29.24	15.09	273	424	535	1,555	637
217H80	1718H5 x 813	6,930	6,300	23.49	15.13	272	440	473	1,683	648
Mean		9,320	8,400	31.50	14.84	268	408	558	1,621	653
LSD (.05)		1,669	NS	5.72	NS	NS	NS	NS	209.2	NS
Coefficient of Variation (%)		15.5	15.4	15.67	4.18	4.9	17.7	21.5	11.1	11.2
F value		2.1*	2.0	2.13*	1.47	1.7	1.6	1.7	2.4*	1.7

*Exceeds the 5% point of significance (F = 2.006).

VARIETY TEST, CLARKSBURG, CALIFORNIA, FALL HARVEST, 1973
By American Crystal Sugar Company
32402

6 replications, Randomized Block Design
2 row plots, 35 ft. long, 30 in. rows

Planted: March 25, 1973
Harvested: September 10, 1973

Variety	Acre Yield: Gross Sugar Pounds	Acre Yield: Recov. Sugar Pounds	Beets Tons	Sucrose Percent	Recov. Sugar/Ton Pounds	Amino N PPM	Na PPM	K PPM	Impurity Index
223-3H16	12,150	10,850	39.29	15.48	277	534	618	1,616	714
C0705H0 x 67-436	11,980	10,920	34.03	17.62	321	508	526	1,595	590
CG705H0 x 67-4T33	11,810	10,800	36.78	16.01	293	367	710	1,364	576
(562H0 x 546) x 67-436	11,810	10,670	33.47	17.63	319	573	598	1,635	645
US H10B	11,580	10,420	36.69	15.77	284	473	617	1,637	667
68-313 MS x C-813T	11,460	10,190	39.06	14.56	259	455	684	1,742	750
F66-569H3 x 67-436	11,140	10,050	31.90	17.55	317	551	608	1,710	650
C0705H0 x FC 902	10,980	9,990	34.04	16.14	294	432	494	1,598	597
C0705H0 x 68-432	10,980	9,950	32.97	16.57	300	463	559	1,717	630
C0705H0 x 65-2T2	10,940	9,940	34.19	16.01	291	446	623	1,442	612
223-2H16	10,850	9,680	37.49	14.44	258	434	709	1,594	720
C0705H0 x 66-405B	10,740	9,760	31.84	16.87	307	446	525	1,685	599
Mean	11,370	10,270	35.14	16.22	293	473	606	1,611	646
LSD (.05)	NS	NS	NS	0.92	19.56	75.4	126.8	155.4	81.5
C.V. (%)	15.17	15.39	13.85	4.90	5.77	13.8	18.1	8.3	10.9
F value	0.48	0.47	1.74	11.22**	9.65**	4.79**	2.53*	4.08**	3.90**

*Exceeds the 5% point of significance (F = 1.97).
**Exceeds the 1% point of significance (F = 2.59).

VARIETY TEST (CALIFORNIA VARIETIES), EAST GRAND FORKS, MINNESOTA, FALL HARVEST, 1973
By American Crystal Sugar Company
38401

6 replications, Equalized Random Block Design
2 row plots, 35 ft. long, 32 in. rows

Planted: May 7, 1973
Harvested: September 26, 1973

Variety	Description	Acre Yield: Gross Sugar Pounds	Acre Yield: Recov. Sugar Pounds	Beets Tons	Sucrose Percent	Recov. Sugar/Ton Pounds	Amino N PPM	Na PPM	K PPM	Impurity Index
Y204H8	F70-546H3 x Y104	6,430	5,510	25.04	12.84	220	615	461	2,018	952
217H80	1718H5 x 813	6,320	5,430	24.32	13.00	223	647	370	2,047	943
217H81	1718H52 x 813	6,280	5,420	24.25	12.96	224	605	356	2,068	917
217H52	8522H1 x 813	6,240	5,400	24.00	12.99	225	624	359	1,868	890
217H16	F69-546H5 x 813	6,220	5,320	24.15	12.88	220	658	399	2,065	970
217H79M	1705H72M x 813	6,210	5,320	24.31	12.77	219	619	409	2,076	955
Y227H8	F70-546H3 x Y127	6,180	5,380	23.53	13.13	229	591	381	1,855	860
Y204H79M	1705H72M x Y104A,B	6,140	5,270	24.76	12.39	213	579	456	1,963	947
Y222H8	F70-546H3 x Y022	6,130	5,290	24.26	12.64	218	601	413	1,898	918
217H82	1718H54 x 813	6,100	5,260	23.73	12.86	222	595	404	2,013	918
217H62	8536H1 x 813	5,950	5,120	23.00	12.94	223	621	368	2,038	925
American #2 Hybrid "B"		5,890	5,130	22.70	12.97	226	581	529	1,627	861
Mean		6,170	5,320	24.00	12.87	222	611	409	1,961	921
LSD (.05)		288	NS	1.03	NS	NS	NS	50.0	149.4	NS
Coefficient of Variation (%)		4.02	4.27	3.70	2.87	3.64	9.5	10.5	6.6	7.4
F value		2.16*	1.58	3.46**	1.67	1.63	1.08	8.49**	6.25**	1.62

*Exceeds the 5% point of significance (F = 1.97).
**Exceeds the 1% point of significance (F = 2.59).

INTERSPECIFIC HYBRIDIZATION

VULGARIS-PROCUMBENS HYBRIDS

Helen Savitsky

Experiments were conducted with the progenies of nematode resistant vulgaris-procumbens trisomics with the objectives of maintaining in the backcross populations the B. procumbens chromosome responsible for nematode resistance, and the development of diploid nematode resistant plants. Plants were tested for nematode resistance in three experiments: (1) in the progenies of open pollinated trisomics, (2) in the progenies of trisomics in which the young buds were irradiated by gamma rays, (3) in plants grown from seed collected on trisomics and irradiated by gamma rays.

Experiment 1 - Trisomic plants were allowed to flower in groups (sib mated) and were also pollinated by diploid nematode susceptible beets. Four hundred and twenty plants in the progenies of B_6 and B_7 trisomics were tested for nematode resistance and 49 nematode resistant trisomics plus one diploid nematode resistant plant were selected. This was the third nematode resistant diploid plant selected in the progenies of open pollinated trisomics.

Experiment 2 - The trisomic plants were irradiated with 1000,1500, 1800, 2000, 2500, and 3000 rentgen units at three stages of bud development: (a) when floral axes had only very young buds (in premeiotic stage), (b) when many young buds at the top of floral axes were still at premeiotic or meiotic stage and the lower buds were in the postmeiotic stage, and (c) when the lower buds had started to flower and those on the top of the branches were in an early stage of development. The irradiated plants flowered in groups and were also pollinated by diploid nematode susceptible plants. The B_5, B_6, and B_7 trisomics were irradiated during 1972 and 1973. The progenies of irradiated trisomics tested in 1973 consisted of 600 plants from which 64 nematode resistant plants were selected. Fifty selected plants were typical trisomics with 19 chromosomes. Fourteen nematode resistant plants differed morphologically from trisomics. Some had oval-shaped leaf blades and resembled diploid sugarbeet; the others had very small leaves or were dwarfed. A cytological study showed that all but three of the plants had 19 chromosomes. One plant was diploid and had 18 chromosomes. The other two plants had 18 chromosomes plus two centric fragments. Four of the nematode susceptible plants from the irradiated trisomics were abnormal. They were dwarfed and had small leaves. Two of these plants had 18 chromosomes, whereas, the other two had 17 chromosomes with two centric fragments. The centric fragments arose from breakage at the centromere region of the 19th chromosome in resistant plants and from breakage of the 18th chromosome in nematode susceptible plants.

The appearance of morphologically deviating trisomics suggests that some structural chromosomal changes or gene mutations were caused by irradiation. The presence of chromosomes fragments indicates that irradiation caused the breakage of chromosomes. Of great importance is the appearance of a diploid nematode resistant plant in the progeny of an irradiated trisomic which could result from translocation between a B. vulgaris and a B. procumbens chromosome. Irradiation of young buds at premeiotic and meiotic stages (a and b stages of bud development) was effective. The breakage of chromosomes was observed after irradiation by 1800 and 2500 rentgen units.

Investigation of nematode resistant plants selected after irradiation showed that breakage of chromosomes, possible structural changes of chromosomes, and survival of gametes with changed chromosomes occurred infrequently. The investigation further showed that a reasonably large scale of irradiation was required to obtain the desired results.

Experiment 3 - The pregerminated seeds of trisomics were irradiated in 1972 with 800, 1000, 1200, 1500, 1800, 2500, and 3000 rentgen units. Seeds were soaked in water for three hours and then placed on blotting paper at room temperature for 36 hours. When the root tips started to show in a few seeds, they were refrigerated and exposed to irradiation the next day. One would expect that pregerminated seed would be more sensitive to irradiation than the dry seed. Resistance tests with plants from these seeds were started in 1972 and finished in 1973. Sixty-seven plants were selected from a population of 610 and were studied cytologically in 1973.

The effect of irradiation of pregerminated seed should be manifest as mixoploidy. The individual cells could differ in chromosome number and in chromosome structure. However, all nematode resistant plants grown from irradiated seed were found to be pure trisomics and a variation in chromosome number in the different cells of the root tips was not observed. Irradiation of seed was not effective in this experiment. Possibly, the cells with chromosomes changed by irradiation grew slowly or were inviable and were overtaken by normal cells in the growing plants.

A total of 1,630 plants was tested for nematode resistance in these three experiments. From these plants, 180 resistant trisomics (11.04%) and two resistant diploids were selected. Their authenticity will be verified by resistance transmission tests in the next generation.

Obtaining monogerm vulgaris-procumbens trisomics

Two monogerm nematode resistant plants have been obtained from pollination of multigerm nematode resistant trisomics with the pollen of the diploid monogerm SLC 91. One of these plants was bagged and its selfed progeny was tested for nematode resistance. Eleven monogerm nematode resistant trisomics were selected in the progeny of this plant. Another monogerm resistant trisomic was irradiated by 2500 rentgen units

at the premeiotic stage. This plant was pollinated by diploid multigerm beets because its pollen was severely damaged by irradiation. From the progeny of this plant were selected five Mn nematode resistant plants (chromosome number unknown). These plants will produce new monogerm resistant trisomics or possibly, a diploid nematode resistant monogerm beet if crossing-over occurs in the meiosis of these plants. This experiment showed that the allelomorph Mm is located in the B. vulgaris chromosome of trisomic plants. The B. procumbens chromosome responsible for nematode resistance does not have the gene m. All trisomics were MM and self-sterile. The gene m was transferred from the pollinator by the B. vulgaris chromosome which met its homologous chromosome in the haploid set of B. vulgaris chromosomes in the trisomic plant. Therefore, no difficulties will occur in the transmission of the monogerm character from nematode susceptible sugarbeet plants to diploid nematode resistant beets.

Obtaining a diploid nematode resistant sugarbeet

Two nematode resistant diploid plants with 18 chromosomes were selected in 1972 from the progenies of nematode resistant open-pollinated trisomics. They were derived from crossing-over between B. vulgaris and B. procumbens chromosomes. Crossing-over between chromosomes of these species is very rare and occurs only in a few trivalent chromosome associations. For this reason nematode resistant diploid plants are difficult to obtain. The two selected plants flowered in 1973 and were pollinated by diploid nematode susceptible beets. Their progenies were tested for nematode resistance. Both plants transmitted the resistance to the next generation. Seventy-three nematode resistant diploid plants were selected from 484 offspring of the first plant. Thirteen nematode resistant diploids were selected from 152 offspring of the second plant. The second plant was sick and very sterile. The diploid resistant plants resembled sugarbeet. Their leaves were broad (not elongated as in trisomics), light green, and soft. The plants were free of tumors and were not easy bolting.

The gene for nematode resistance has now been transferred from B. procumbens to sugarbeet. Further work is needed to develop homozygous nematode resistant lines with a sufficient rate of resistance transmission. Selection of resistant plants in the progenies of irradiated and non-irradiated trisomics will be continued because every diploid plant derived from crossing-over or translocation may differ in the length of the segment acquired from B. procumbens chromosome.

VULGARES-COROLLINAE HYBRIDS

Helen Savitsky and J. S. McFarlane

Vulgaris-corolliflora hybrids. Ten diploid B_5 plants highly resistant to curly top were obtained this last year. They were intercrossed by exchanging bags. Seeds were harvested in 1973 and the young F_1 plants were tested for curly top resistance. Plants were inoculated twice with a highly virulent "Logan" strain of curly top virus. Inoculation of plants and selection for resistance were done by Dr. McFarlane. Eight hundred seedlings were inoculated and of these 14 highly resistant plants with no curly top symptoms, and 45 plants with very mild symptoms were selected.

Chromosome numbers were counted in the 14 highly resistant plants. They all had 18 chromosomes. These highly resistant plants are healthy normal sugarbeets. The rate of resistance transmission was 7.38 percent. The selected curly top resistant plants will be studied and intercrossed for selection of curly top resistant plants with a higher rate of resistance transmission.

Vulgaris-trigyna hybrids. The male sterile B_1 population selected for curly top resistance was maintained and pollinated again in 1973 to obtain more B_2 seed. Fertility of these hybrids was not high. Selection of B_2 plants for curly top resistance was continued. Three hundred and ninety B_2 plants were inoculated twice with the "Logan" strain of curly top virus. Inoculation of plants and selection for curly top resistance was done by Dr. McFarlane.

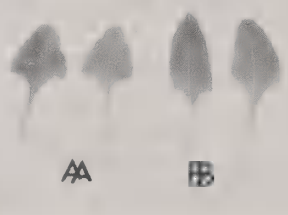
The B_1 population was comparatively uniform for curly top resistance and high vigor. In the B_2 generation, a wide range of segregation was observed in vigor and in the degree of resistance. Many B_2 plants were curly top susceptible; however, 74 highly resistant B_2 plants were selected.

It may be expected that male-sterility and the lack of effective pollen will continue to be problems in the B_2 generation. Therefore, the selected plants will be propagated in a group and diploid sugarbeet pollinators will be included.

Apparently, some B. trigyna chromosomes were already lost in the B_1 generation. Cytological study and further selection are necessary if highly curly top resistant lines with good vigor are to be developed.

Nematode resistant plants

Vulgaris-procumbens trisomics Diploid B. vulgaris



Leaves from nematode resistant plant

A - Diploid B. vulgaris B - Vulgaris-procumbens trisomics

Curly top resistant plants

F_1 vulgaris-corolliflora hybrids B_2 vulgaris-trigyna hybrids

diploid

Beta vulgaris x *B. procumbens* Hybrids

James C. Read

Transmission of nematode resistance through the pollen

This test was conducted to check pollen transmission of sugarbeet nematode (*Heterodera schachtii*) resistance from the 19 chromosome *B. vulgaris* x *B. procumbens* hybrids developed by H. Savitsky. Eleven 19 chromosome sugarbeet nematode resistant plants were crossed with a susceptible sugarbeet line by bagging a resistant plant with a susceptible one, allowing pollination to occur, and then separating before seed maturity. Seeds collected from the susceptible sugarbeet parent were used. A total of 927 plants were tested and one was found to be resistant after three inoculations. Cytology reveals 18 chromosomes for this plant so the extra chromosome was not transmitted through the pollen. Advanced generations of this plant have not been obtained.

Irradiation Studies

The incorporation of the gene or genes for sugarbeet nematode resistance from *B. procumbens* has been hampered by the lack of homology between the chromosomes of sugarbeet and the chromosomes of *B. procumbens* which contains the genes for resistance. Irradiation of the 19 chromosome *B. vulgaris* x *B. procumbens* hybrids was initiated to create translocations between the *B. procumbens* chromosome and a sugarbeet chromosome. Both plants and seeds were irradiated with doses ranging from 500r to 2000r using Co^{60} as the source of irradiation.

Seeds were irradiated either dry or soaked in water for 24 hours prior to irradiation. A total of 1275 plants were obtained from the irradiated seed and 179 were found to be resistant after three inoculations. The only observed effect that could be contributed to irradiation was the recovery of plants containing both diploid and tetraploid sectors. One plant had both 18 and 36 chromosomes and two had 19 and 38 chromosomes. Most of the resistant plants had 19 chromosomes and one had 18 chromosomes. The progeny from these plants have not been evaluated but based upon the above results the number of chromosomal breaks created by this level of irradiation must be low. It is believed that if seeds are to be irradiated much higher doses must be used.

A total of 89 plants have been irradiated at doses ranging from 500r to 2000r. Plants were grouped as to time before anthesis. Two stages were included this year that were not used last year. The stages were (1) just after initiation of florial buds, (2) about a week before anthesis, (3) two to four days from anthesis, (4) just

prior to anthesis, and (5) at anthesis. Sixty-one of these plants were crossed with susceptible sugarbeet lines by bagging the irradiated nematode resistant plants with self sterile sugarbeet lines. The doses used on these plants were 700r, 1000r, 1300r, and 1600r. The remaining 28 plants were allowed to open pollinate.

The extra chromosome from B. procumbens is not transmitted through the pollen so any resistance transmitted through the pollen should represent an incorporation of the gene for resistance into the sugarbeet genome. Most of the susceptible plants will be eliminated on the first inoculation so the number of plants tested can be increased thus increasing the chances of recovering the desired translocation.

A total of 2857 plants have been tested from the susceptible sugarbeet female x irradiated nematode resistant male crosses. All except one was susceptible through the second check. Additional progenies from these crosses are being evaluated.

The results on the optimum dosage to use was not consistent with the preliminary results obtained last year. Studies of meiosis at the different doses did not reveal as many cells showing abnormalities as previously. This inconsistency can be explained by individual plant differences in susceptibility to irradiation damage and the small number of plants studied cytologically. The results obtained on seed set also indicates differences in susceptibility to irradiation. There is no significant difference in amount of seed set between 700r, 1000r, 1300r, and 1600r on the irradiated plants or those pollinated with pollen from irradiated plants (Table 1 and 2). There is considerable variation between individual plants within each treatment. Further studies will be conducted to determine if there is individual plant differences to susceptibility to irradiation damage and to find the best dosage to use when attempting to transfer a character in this manner.

Table 1. Amount of Seed in Grams From Irradiated Nematode Resistant Plants.

	700	1000	1300	1600
	1.7	1.8	4.0	0.6
	2.6	3.6	5.6	3.4
	5.5	2.7	4.4	6.1
	3.4	2.2	4.1	2.2
	3.8	3.0	0.5	1.1
	4.0	1.5	0.2	2.2
	2.2	4.2	1.9	3.0
	1.0	1.7	2.3	1.0
	1.8	1.0	0.8	0.6
	0.8	0.3	2.0	2.4
	1.3	1.0	1.0	0.4
	1.8	2.2	2.5	
	0.6	0.8	1.5	
	1.5	1.6	3.1	
		3.8	1.2	
		2.8		
Total	32.0	34.2	35.1	23.0
Mean	2.286	2.1375	2.340	2.09

Table 2. Amount of Seed in Grams From Plants Pollinated with Pollen from Irradiated Nematode Resistant Plants.

	700	1000	1300	1600
	1.1	0.5	3.0	0.7
	3.1	2.7	2.3	1.3
	2.6	3.0	0.3	0.4
	0.4	1.3	2.2	2.1
	3.8	2.5	5.0	3.8
	2.2	2.3	1.2	1.6
	3.3	3.5	1.5	3.1
	1.0	2.3	3.8	2.8
	1.2	4.0	1.0	3.5
	3.1	2.2	4.7	2.4
	4.2	1.8	5.1	1.2
	3.2	3.8	4.4	
	1.8	2.0	3.2	
	2.9	4.8	0.5	
		4.6	1.5	
		2.4		
Total	33.9	43.7	39.7	22.9
Mean	2.421	2.731	2.646	2.082

EVALUATION OF CURLY TOP VIRUS FIELD INOCULATION ON SUGARBEET

I. O. Skoyen and J. E. Duffus

A second experiment conducted in 1973 was designed with objectives similar to those of a test conducted in 1970, see Sugarbeet Research-1970 Report, B71-B73. These objectives included (1) additional testing of a method designed to insure a high percentage of infected plants with individual field plant inoculations while uninoculated plants remained free of curly top virus, (2) to determine the plant age where inoculation would produce the highest infection and cause damage but not kill the plants, (3) to determine the plant age where inoculation and infection caused minimum damage and (4) to determine the effect on root yield, percent sucrose and the quality factors, amino nitrogen, sodium (Na) and potassium (K) of various levels (percentages) of infection with curly top virus.

The monogerm hybrid variety, US H10B (Lot No. 1068) was sown April 24, 1973 in a split-plot design with 4 replications, at the U. S. Research Station, Salinas, California. The main plots were two dates of inoculation, June 5 and July 5, 1973. Sub-plots were six levels of inoculation, 0, 10, 20, 40, 80 and 100 percent. Inoculation levels were completely randomized over each main plot. Plot size was two rows by 30' long. The test plot was thinned May 25, 1973. Stands in each plot row were reduced to 25 plants prior to inoculation. US H10B is widely grown in California and has the F_1 hybrid 546H3 as the seedbearing parent and the open pollinated line 117 as the pollen parent. The variety has moderate resistance to prevalent strains of curly top virus. A moderately severe strain of curly top virus, designated the Los Banos strain, was used for the virus treatments. Inoculations were made six weeks and ten weeks after seeding.

Inoculations were made by attaching two small cages containing two or three viruliferous leafhoppers to the leaves of the appropriate number of randomly selected test plants. The same procedure was used for both dates of inoculation. Construction of the cages is described in Sugarbeet Research-1970 Report, page B71. Cages remained on test plants one week and were checked for leafhopper survival during that time. Any cages with dead leafhoppers were replaced with cages containing living insects. Insect survival remained very high during the inoculation period.

Plot fertilization and irrigation practices were designed to sustain adequate growth. The test was harvested October 30, 1973. Roots were weighed individually so that component yields of curly top diseased and healthy roots could be compared. Root samples for sugar analysis were also separated into diseased and healthy components for comparing differences in sucrose content.

RESULTS AND DISCUSSION

Test results and analysis of variance mean squares for the total yield for the various treatments are shown in Table 1. There were significant differences between plant age at the time of inoculation for both tons per acre (TPA) and gross sugar. For percent sucrose, the difference was highly significant. Differences were highly significant for percent curly top infection and also for the interaction between plants inoculated June 5 and percent infection for TPA and gross sugar. Sucrose content differences due to percent curly top infection were not significant. The data show that young plants were most severely affected by curly top infection. The interaction indicates that the younger the plants, the higher the percent infection and the greater the root yield reduction.

As in 1970, the percent curly top infection that could be obtained in field inoculated plants was of primary interest in the experiment. The observed percent curly top virus infection in plants six weeks old when inoculated agreed closely with the percentages of plants inoculated in the different treatments. This substantiates our 1970 results and establishes that field inoculations can be used to measure damage due to curly top in areas where non-inoculated check plots can be kept free of infection.

Inoculation of 10-week-old plants demonstrated again, as in 1970, the increased resistance to infection and resistance to damage from curly top virus as plants increase in size and/or age. The greatest reduction in gross sugar yield for plants inoculated 10 weeks after seeding was 15% compared with 67% reduction for plants inoculated 6 weeks after seeding. This demonstrates that sugarbeet plants gain both phases of resistance to curly top early in their growth cycle. Obviously, widespread infection with a moderately severe strain of curly top virus when beet plants are young could be disasterous to commercial sugarbeet production. The possibility exists for such an occurrence since more virulent strains of the virus are evolving which are capable of causing severe damage even in varieties that have had recent improvements in resistance incorporated into them. Also, late infection which is not easily discernible by symptom expression can cause significant yield losses.

The differences shown in Table 1 for ppm Na and K probably are not valid. Values for both Na and K were erratic in their occurrence among treatments and replications. Additional testing with larger numbers of samples will be needed to establish that there are real differences.

Two years of exploratory testing (in 1970 and 1973) have established that reasonable confidence can be placed in the technique we used to produce high levels of curly top infection with field inoculations. Although further testing and refinement are warranted, use of the technique should make it possible to compare the damage caused by

combinations of viruses, such as curly top and virus yellows, with that of the viruses singly and with healthy plants. Further, it should be possible to establish a damage index due to curly top virus infection in commercial fields of sugarbeet based on percent infection, approximate age or size of plants when infected, the degree of stunting exhibited by infected plants, and the observed degree of recovery and subsequent growth of infected plants.

Table 1. Means and mean squares for effect of curly top virus on sugarbeet when different percentages of plants are inoculated at different stages of growth. (Variety US H10B)

Date & Percent Inoculation	Obs. Infection	Acre Yield			ppm Root			Root Rot
		Gross Sugar	Beets	Sucrose	NH_2-N	Na	K	%
	Percent	Pounds	Tons	Percent				
June 5, 1973								
0	0	8,084 ab[1/]	26.0 a	15.6 a	391	313	2156	11.8
10	10.8	8,075 ab	26.6 a	15.2 ab	377	347	1978	9.5
20	21.8	6,689 bc	23.7 ab	14.6 b	372	369	1806	7.9
40	39.8	6,455 c	21.5 b	14.6 b	461	345	2027	8.5
80	75.3	4,284 d	14.3 c	15.0 ab	431	363	1969	7.3
100	94.8	2,676 e	9.1 d	14.9 b	395	378	1562	2.8
Mean	40.4	6,143	20.5	15.0	410	354	1928	8.0
July 5, 1973								
0	0	8,084 ab	26.0 a	15.6 a	391	313	2156	11.8
10	7.5	8,467 a	26.6 a	15.9 a	374	265	1855	3.8
20	14.8	7,569 bc	24.0 ab	15.8 a	382	255	2065	3.5
40	30.8	6,972 bc	22.0 b	15.9 a	397	262	1992	7.5
80	59.5	6,872 bc	22.0 b	15.7 a	382	268	1848	6.0
100	73.3	7,262 bc	23.1 ab	15.7 a	463	222	1826	4.0
Mean	31.0	7,480	23.7	15.8	398	263	1946	6.1
General Mean		6,811	22.1	15.4	404	309	1937	7.0

Variance Table

Source	d.f.	MEAN SQUARES						
		Gross Sugar	Beets Tons	Sucrose Percent	NH_2-N ppm	Na ppm	K ppm	Observed Curly Top Percent
Replication	3	1,418,665	9.97	0.36	13,303	30,771*	12,283	95.7
Inoc. Stage (A)	1	21,430,780*	125.71*	8.42**	3,745	99,009**	3,870	1064.0**
Error a	3	1,333,190	10.89	0.21	1,547	2,304	11,168	16.7
Percent CT (B)	5	14,194,753**	143.80**	0.24	4,685	277	181,153**	8994.6**
A X B	5	7,329,401**	80.44**	0.15	5,503	4,186	74,023*	127.6**
Error b	30	724,170	6.97	0.26	2,660	5,323	23,674	23.6
Total	47							

[1/] Means followed by the same letter not significantly different.

Bacterial Rot of Sugarbeet: I. Varietal Susceptibility

E. D. Whitney and R. T. Lewellen

In 1972, field tests showed the high susceptibility of C413, a yellows resistant line, to bacterial rot. Observations suggested transmission of this susceptibility to hybrids when C413 was used as a parent. Tests were conducted in 1973 to evaluate hybrids, the components of hybrids and other yellows resistant lines to determine the relative susceptibility of these lines. Also of interest was the possibility that virus yellows resistance is associated with bacterial rot susceptibility.

Materials and Methods.--Twelve sugarbeet lines were planted at two locations for evaluation. Three of these lines, C813, Y003 and Maris Vanguard, are yellows resistant; US 75 is the parent of C813; and 546 H3 is the F_1 parent of a number of hybrids, (US H9B and US H10B) currently used. Also grown were varieties which were replaced by the currently grown virus yellows resistant varieties, S301 H8, US H7A, and the male parent of US H7A, F66-64. Two other lines of interest, 2718H54 and HH 23, were also included.

The plots at Woodland and Dos Palos, California, were planted on May 8 and 19, respectively. The experiments were randomized block designs. The plots were inoculated when about 2 months old. The bacterial isolates were grown on King B. Medium for 40 hours. Five isolates were used for each inoculation. Each isolate was suspended in water, standardized (Klett-Summerson colorimeter reading of about 200), and mixed in equal proportions. This stock solution was diluted 1:7 with tap water and sprayed with a pressurized sprayer into the crowns of plants at the rate of approximately 1 liter/100 ft of row. Plots were harvested $5\frac{1}{2}$ months after planting and each beet cut to estimate the percent rot per beet. A six increment scale for estimating percent rot was used; 0, 1, 15, 50, 85, and 100%.

Results.--The results of the tests are shown in Fig. 1. The three most susceptible lines are all related to US 75 and are yellows resistant. The other yellows resistant lines, Maris Vanguard and Y003, are two of the least susceptible. 546 H3, the F_1 parent of US H10B, US H9B and US H7A, is intermediate in resistance. The male parent of US H7A, F66-64, is resistant. S301 H8 and HH 23 are about as susceptible as previously grown varieties, i.e., US 75 and US H7A. The two tests were highly correlated, r=.96.

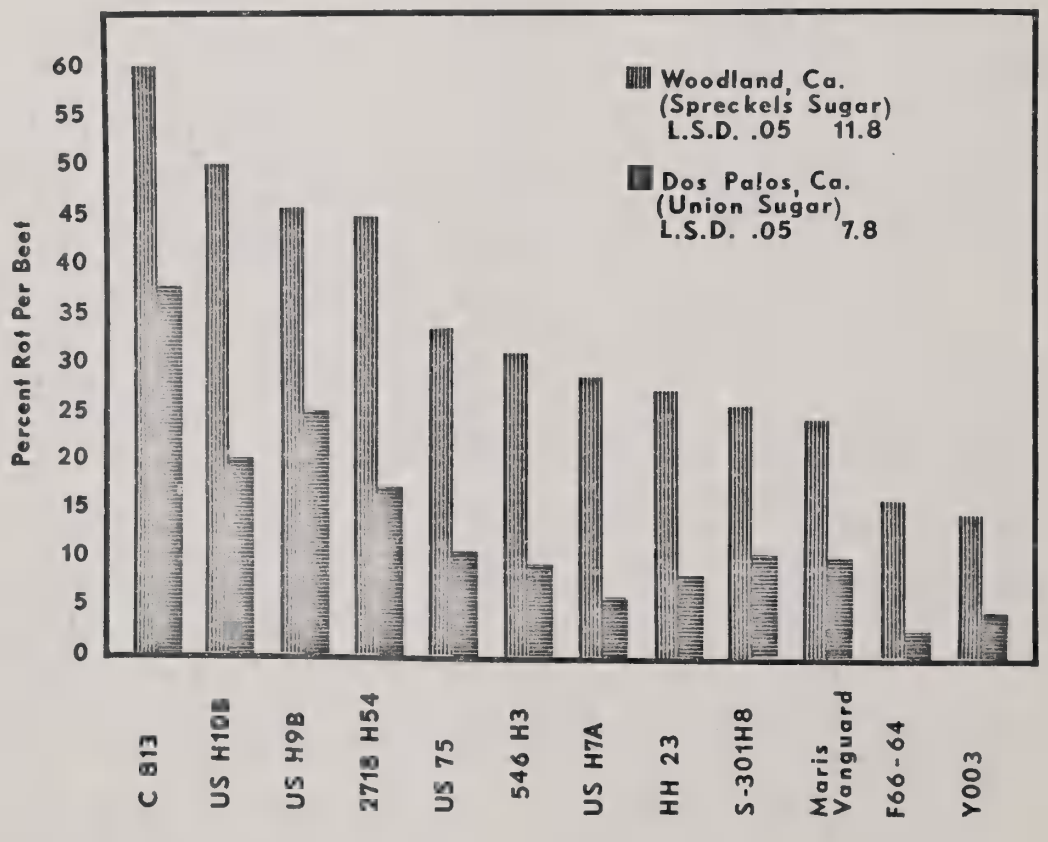
Discussion.--These results substantiate the 1972 results, which showed that the new virus yellows resistant varieties are very susceptible to bacterial rot.

The increased susceptibility of yellows resistant hybrids is to a large extent derived from the male parents, C413 and C813. Although

YOO3 and Maris Vanguard have virus yellows resistance they lack other desirable characteristics, e.g. curly top resistance, which is necessary in varieties grown in California. They do, however, provide a source of resistance that may prove valuable. Some progress could be made by the replacement of 546 H3, the F_1 parent of many hybrids, which is only moderately resistant to the bacterium with a more resistant female parent.

Why C413 and C813 are more susceptible to bacterial rot than their parent US 75 has not been established. Susceptibility does not seem to be associated with yellows resistance but is a weakness which was inadvertently developed in the selection process. However, considerable variation for resistance is evident in C413, which should provide a source of resistance. The difference in percent rot between the two locations appears to be associated with location or fertilization as other treatments were comparable.

Figure 1. Response of inoculated sugarbeet varieties and selections to bacterial rot at two locations in 1973. (Cooperators, Spreckels Sugar and Union Sugar).



Bacterial Rot of Sugarbeet: II. Selecting for Resistance

E. D. Whitney and R. T. Lewellen

Tests in 1972 at Lost Hills, California, suggested that variation in resistance to bacterial rot was present in C413, the virus yellows resistant male parent of US H9A and B. Therefore, a program was initiated to evaluate this resistance and to develop a selection program.

Materials and Methods.--From a strip planting of C413 at Lost Hills, 96 roots were selected that appeared healthy. Natural infection in this planting was about 36%. These roots were numbered, split and one-half of each root was placed in the cold room for photo-thermal induction. The other half was planted in an 8-inch pot of soil for further testing in the greenhouse. Three months after transplanting the half-beets placed in the greenhouse were inoculated with a suspension of four isolates of the bacterium. The inoculum was produced as in the preceding paper except a final Klett-Summerson colorimeter reading of 100 was used. Twelve petioles of each plant were injured by piercing the petiole with a dissecting needle about 1 inch from the base. Inoculum was then sprayed onto the plant until run-off occurred. These plants were then placed in a moist chamber for 4 days and then returned to greenhouse benches. One month after inoculation each root was cut and evaluated for rot resistance. On the basis of the greenhouse test, 13 of the half-roots that had been photo-thermally induced were placed in isolation for seed production. Sixteen susceptible roots and 15 randomly selected roots from untested plants (field tested) were also planted in isolation for seed production. Seed was harvested from individual open-pollinated beets. Six lots of seed from each group and 2 replications of C413, the parent, were planted June 8 in a randomized block design (4 replications) in a field test. These beets were treated similarly to those in the preceding report except they were inoculated at 8 and 12 weeks after planting. The beets were harvested October 15, split and evaluated for percent rot as in the preceding report. Beets from resistant lines that appeared resistant were saved for further testing.

Results.--The results are shown in Table 1. Some progress was made in selecting for susceptibility as well as for resistance. The data show that progress was made in selecting for resistance in both the greenhouse and the field. The mean percent rot per beet was 43.4 for the parent, 44.6 for the susceptible selection, 26.2 for 1 cycle of field selection and 13.9 for 1 cycle of a combination of field plus greenhouse selection.

Discussion.--The fact that progress was made in selecting for both susceptibility and resistance is encouraging. It should be remembered that the susceptible selections were from material that had been grown under field rot conditions (36%) and this may be the reason that they

are nearly equal to the parent. The data suggest that progress can be made either from a field selection program or one based on greenhouse selection. If rapid progress is desired a combination of the two methods would appear applicable. The basis for our selecting for susceptibility was to provide a uniformly susceptible selection for use in inheritance studies as well as a uniformly susceptible selection for field and greenhouse tests.

It has been suggested that susceptibility may be associated with rapid growth which causes the splitting of crowns and petioles. These natural wounds could provide an access for the bacterium to incite infection. Because of this and other unknown effects of selecting for bacterial rot resistance, an essential part of a selection program will be to test the selections for their yield performance, yellows resistance, and other important characteristics.

Table 1. The effect of selecting C413 for bacterial rot of sugarbeet.

	% Rot per beet[1]		
Susceptible[2]	Resistant 1[3]	Resistant 2[4]	Parent[5]
51.2 a[6]	34.7 def	20.1 ij	46.8 ab
48.3 ab	31.1 efg	18.3 ijk	40.0 cd
47.2 ab	30.7 fg	16.3 jkl	
42.0 bc	27.7 gh	14.3 jklm	
41.9 bc	23.0 hi	9.9 lmn	
37.1 cde	15.2 jklm	4.5 n	

[1] Mean of 4 replications.

[2] Selected for susceptibility after 1 cycle of field selection for resistance.

[3] One cycle of field selection for resistance.

[4] One cycle of field selection and 1 cycle of greenhouse selection for resistance.

[5] Parent of selected material.

[6] Duncans multiple range test 5%.

NEMATOLOGY STUDIES

Arnold E. Steele

Overwintering of Meloidogyne incognita in Root galls of Sugarbeet in the Salinas Valley of California.

It has long been known that a number of taxonomically diverse nematode species may survive by overwintering on or within undecomposed host-root debris. The persistence of this debris may also greatly influence the efficacy of soil nematicides.

Recent experiments (5) have shown that Heterodera schachtii can develop and reproduce on small pieces of storage root of several large-rooted host plants, including sugarbeet, suggesting that this nematode may increase on post-harvest root debris. This paper reports results of attempts to determine the ability of Meloidogyne incognita larvae to overwinter in sugarbeet galls and infect host plants.

Roots of sugarbeets harvested on November 28, 1972 from a 7-acre field near San Ardo, California were heavily infested with Meloidogyne incognita (Kofoid and White, 1919) Chitwood, 1949 (Fig. 1). The beets had been grown in 2-row beds with furrow irrigation. Because of an extended period of rainy weather after harvest, the field had remained untilled for more than 3 months.

Soil movement during discing and listing operations on March 17 and 19, respectively, uncovered numerous galls. These galls were found on the surface of the beds and in the furrows, either relatively free of soil (Figs. 2 and 3) or within clods (Fig. 4). Many galls were found in an area of the field that contained soil composed of 21% clay, 37% silt, and 42% sand, but only a few galls were found in an area containing soil composed of 14% clay, 18% silt, and 68% sand. This suggests that more galls may have been separated during harvest from beets grown in the area of the field with the higher clay content.

The recently exposed beet galls were collected, washed, divided into 5 groups by size, and weighed. Each of these groups was subdivided and placed 3-4 inches below the soil surface in 8" pots containing sterilized soil. Tomato seedlings, started from seed in steam-sterilized sand, were transplanted to each pot. After the tomatoes had grown 60 days, the plant roots were examined for galls and root-knot nematodes.

On April 4, fifteen days after the beds were listed, galls that appeared dry but not decomposed were collected from the field in furrows and on top of the planting beds. These galls were added to pots containing young tomato plants in the manner previously described.

Results listed in Table 1 show that galls within 4 of 5 groups contained larvae and/or eggs of M. incognita that infected tomato. Although the infection index appeared to be influenced more by numbers of galls than weight of galls, other work (1) has revealed a high positive correlation between gall area and number of larvae in the gall. Sugarbeet root galls that became dry from field exposure for two weeks did not contain viable eggs or larvae. Addition of these galls to soil containing growing tomato plants did not produce galling of tomato roots.

Previous work (4) has demonstrated that tomato galls infected with adult root-knot females had eggs and larvae within cavities. Microscopic examination of serial sections of several galls did not reveal corridors connecting cavities with the root exterior, suggesting that second-generation larvae can reinfect tomato without first entering the soil. The present study establishes that surface-cleaned, overwintered galls of sugarbeet contain nematodes that can reestablish infections in susceptible plants.

Greenhouse studies (2, 3) have shown that methyl bromide or a 1,2-dichloropropane, 1,3-dichloropene mixture can penetrate large unrotted galls and kill nematodes within. However, root-knot galls encased in soil clods may pose a problem for fumigant penetration. It is likely that these clods could be effective barriers to penetration of galls by volatile nematicides. Under these conditions, special pretreatments of fields before fumigation (i.e., repeated turning of soil or extended period of fallow) or use of systemic materials may be required for adequate crop protection.

Table 1. Infectivity of Meloidogyne incognita within galls of sugarbeet 60 days after inoculation to pots containing tomato.

Group number	Number of galls	Total wt. of galls (gm)	Mean wt. per gall (gm)	Percent of total gall mass	Infectivity (Root-knot index)[1]
1	7	132.0	18.9	6.5	0.5
2	22	225.0	10.3	20.6	2.0
3	23	122.0	5.3	21.5	2.0
4	29	87.2	3.0	27.1	0
5	26	32.55	1.25	24.3	3.0

1/ Root-knot index: 0 - no galls; 1.0 - few galls; 2.0 - lightly galled; 3.0 - moderately galled; 4.0 - heavily galled.

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2. Lear, B. 1951. Use of methyl bromide and other volatile chemicals for soil fumigation. Cornell University, Agric. Exp. Stn. No. 303. 48 p.

3. Stark, F. L., Jr., and Lear, B. 1947. Miscellaneous greenhouse tests with various soil fumigants for the control of fungi and nematodes. Phytopath. 37: 698-711.

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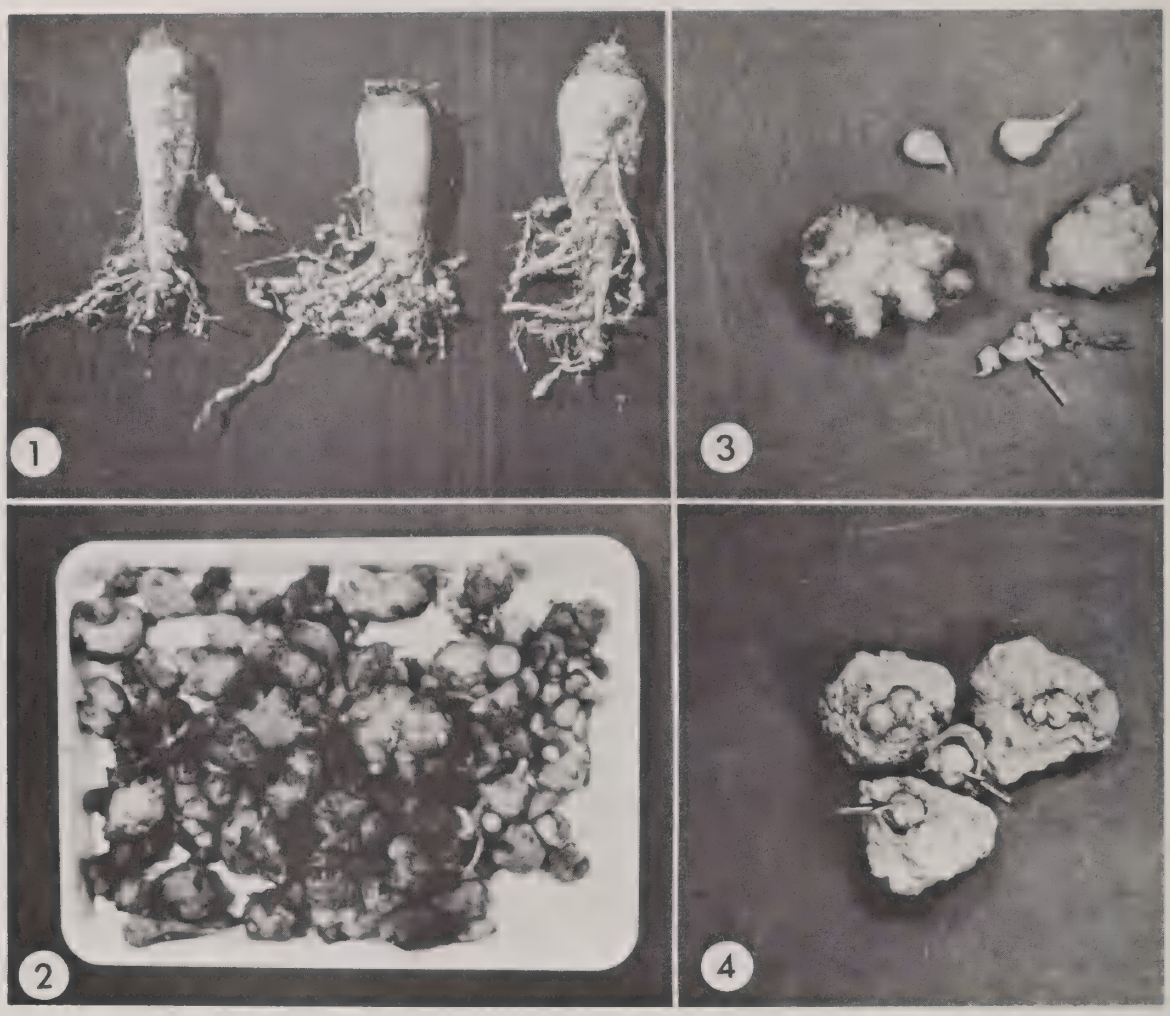
5. Steele, A. E. 1972. Development of Heterodera schachtii on large-rooted crop plants and the significance of root debris as substratum for increasing field infestations. J. Nematol. 4: 250-256.



Figs. 1-4. Sugarbeet root galls infected with Meloidogyne incognita. Fig. 1. Galls attached to sugarbeet at harvest (x 1/5). Fig. 2. Nematode infected galls collected from field 4 months after harvest (x 1/3). Fig. 3. Illustrates variability of gall size. Mean wt of large galls--24 gm; mean wt of small galls--1.9 gm (x 3/4). Fig. 4. Galls within clay loam soil clods (x 1/3).

Effects of pretreatment with Bunema, a commercially available nematicide, or an extract of asparagus on hatching and emergence of larvae from cysts of Heterodera schachtii

In two separate tests, water solutions of Bunema (Potassium N-hydroxymethyl-N-methyldithiocarbamate) supplied by Buckman Laboratories, Inc., Memphis, Tennessee, and Dihydroasparaglutic acid (B, B'-Dithiolisobutyric acid) supplied by Dr. Joe Corse, Crops Laboratory, USDA-ARS-WR, Berkeley, California, were tested for lethal effects to embryonated larvae of the sugarbeet nematode, Heterodera schachtii. Cysts obtained from infected plants grown in a greenhouse were treated 4 weeks with Bunema or 2 weeks with extract of asparagus. After pretreatment, the cysts were removed from the chemical solutions and placed in several changes of tap water. The cysts were then placed in sugarbeet root diffusate to stimulate hatching and emergence of larvae as a means of assessing the nematicidal effects of the chemical treatments. Counts of emerged larvae are listed in table 2.

All treatments of Bunema were lethal to larvae within eggs of the sugarbeet nematode. However, since the 100 ppm concentration of Bunema did not give complete control, the nematicidal efficacy will probably decrease below this concentration.

One hundred ppm was the lowest concentration of Dihydroasparaglutic acid which exhibited nematicidal effects. However, the effect was not of sufficient magnitude to warrant additional testing of this material.

Table 2. Influence of Bunema or asparagus extract on hatching and emergence of larvae from cysts of Heterodera schachtii.

Conc. (ppm)	Bunema[1]	Asparagus extract[2]
Tap water	245[3]	192[3]
1	-	1983
10	-	2172
100	12	994
500	2	-
1000	2	12
2000	2	-
Beet root diffusate	2796[3]	2113[3]

1/ Means of 4 replications of 25 cysts treated 4 weeks with Potassium-N-hydroxymethyl-N-methyldithiocarbamate followed by 2 weeks with sugarbeet root diffusate.

2/ Means of 5 replications of 25 cysts treated 2 weeks with Dihydroasparagusic acid (B, B-Dithiolisobutyric acid) followed by 4 weeks in sugarbeet root diffusate.

3/ Treated the full duration of the test with either tap water or sugarbeet root diffusate as indicated.

Results of 1973 test of nematicides for control of root knot and sugarbeet nematodes

The field selected for the site was located near San Ardo, California. The field was moderately infested with Meloidogyne incognita and Heterodera schachtii and the soil varied from sandy loam to clay loam. Plots consisted of 4 beds, 100 feet long with 2 rows per bed.

In two separate tests, each of 12 treatments were replicated 6 times in randomized complete-block designs. Granular formulations of Mocap, Nemacur, Temik and Vydate were applied at planting at 4 lbs active/acre in 5-inch bands placed 2-3 inches deep. Additional treatments of Temik 10G were as follows: 4 lbs/acre side-dressed at furrow depth 3 inches from the seed row on the furrow side at planting or at thinning, 2 or 4 lbs/acre banded at planting as described, 2-3 inches deep or at furrow depth, followed by 2 lbs/acre side-dressed at thinning.

In the first test, at planting treatments of Mocap and Temik were applied March 19, 1973. Rain delayed application of other treatments until April 2 when Nemacur and Vydate were applied. In the second test all "at planting" treatments were applied on April 2. Sugarbeets were planted in plots of both tests on April 4.

Sugarbeet plants were obtained from treated and untreated plots on May 15 and June 21. The plants were evaluated for the presence of root knot and sugarbeet nematodes.

In Test #1, all treatments significantly reduced root knot but not sugarbeet nematode in plants sampled on May 15. In Test #2, 4 lbs/acre Mocap or Vydate were the only treatments which did not significantly reduce sugarbeet nematode. Data taken on root knot was not statistically significant for Test #2. When data on root knot and sugarbeet nematodes were combined (not shown), data of both tests were highly significant with all treatments significantly lower than checks.

At the second sampling date, beets from plots treated with 4 lbs/acre applied in a band 3 inches below the soil at planting, or as a side dress at thinning, were not significantly different from untreated checks in root knot infection. Data for sugarbeet nematode taken at the second sampling date was not statistically significant. Due to a number of factors which influenced sugarbeet stands, yield could not be obtained from the test plots.

Information on nematicides evaluated:

1) Mocap 10G* - (ethoprop) O-Ethyl S, S - dipropylphorodithioate.
Mobile Chemical Co., Richmond, Virginia.

2) Nemacur 15G* - (Bayer 68, 138) Ethyl 4 - (Methylthio) - M - tolyl isopropyl phosphoramidate.
Chemagro, Corp., Kansas City, Kansas.

3) Temik 10G* - (aldicarb) 2 - methyl - 2 - (Methylthio) proprional-dehyde) - methylcarbamoyl) oxime.
Union Carbide Corp., Salinas, California.

4) Vydate 10G* - (DPX 1410) S - methyl 1 -(demethyl carbamoyl) - N - (methylcarbamoyl) osy
E. I. duPont de Nemours and Co., Wilmington, Delaware.

* Mention of a trademark or proprietary product does not constitute guarantee of warranty of the product by the U. S. Department of Agriculture and does not imply its approval to the exclusion of other products that may also be suitable.

Table 3. Effects of nematicides on infection of sugarbeet roots sampled May 15, 1973 with root knot and sugarbeet nematode.

Treatment Number	Treatment	Rate and application method[2]	Test #1 mean root weight	Test #2 mean root weight	Test #1 number root knot nematodes	Test #2 number root knot nematodes	Test #1 number sugarbeet nematodes	Test #2 number sugarbeet nematodes
1	Check	- -	7.1[1]	7.0	61.0	16.2	15.8	20.8
2	Mocap	4/A Band 3 AP	4.4	4.6	17.0	15.5	8.8	12.8
3	Nemacur	4/A Band 3 AP	6.8	6.2	17.3	13.0	27.0	7.8
4	Vydate	4/A Band 3 AP	6.0	8.8	21.0	14.7	17.5	11.8
5	Temik	4/A Band 3 AP	7.7	6.5	7.2	7.8	1.2	6.7
6	Temik	4/A Band 5 AP	7.7	7.0	8.5	1.7	4.2	2.8
7	Temik	4/A SD AP	7.2	10.6	15.7	4.0	10.5	4.2
8	Temik	4/A Band 3 AP	6.4	8.2	0.5	20.7	4.5	8.7
9	Temik	4/A Band 5 AP	7.1	7.8	1.0	4.8	5.0	7.0
10	Temik	2/A Band 3 AP	5.9	7.5	21.2	11.0	8.7	1.5
11	Temik	2/A Band 5 AP	7.2	9.9	3.2	6.8	4.7	3.8
12	Check	- -	6.5	7.8	10.3	23.8	19.3	20.7
Significance					**	NS	NS	*
					LSD .05 = 16.6			11.9

[1] Mean of 10 plants.

[2] AP - at planting; SD - side dressed.

Table 4. Effects of nematicides on infection of sugarbeet roots sampled June 21, 1973 with root knot and sugarbeet nematode.

Treatment Number	Treatment	Rate and application method[2]	Test #1 mean root weight	Test #2 mean root weight	Test #1 root knot index	Test #2 root knot index	Test #1 sugar-beet nematode	Test #2 sugar-beet nematode
1	Check	- -	230.2[1]	189.4	2.0	1.3	113.2	154.8
5	Temik	4/A Band 3 AP	326.4	304.8	1.4	0.9	71.8	87.0
6	Temik	4/A Band 5 AP	400.5	428.6	0.7	0.3	36.8	84.2
7	Temik	4/A SD AP	441.5	680.3	0.9	0.5	103.5	104.0
8	Temik	4/A Band 3 AP + 2/A SD-AT	352.0	433.6	0.8	1.3	44.8	81.0
9	Temik	4/A Band 5 AP + 2/A SD-AT	358.2	462.3	0.6	0.5	68.5	66.5
10	Temik	2/A Band 3 AP + 2/A SD-AT	292.9	359.8	1.0	1.2	64.5	44.1
11	Temik	2/A Band 5 AP + 2/A SD-AT	381.5	461.0	0.8	0.6	55.8	138.3
12	Temik	4/A SD-AT	298.0	451.7	1.6	1.3	86.8	50.0
	Significance				* *	N S	N S	N S

LSD .05 = 0.7

[1] Mean of 5 plants.

[2] AP - at planting; SD - side dressed; AT - at thinning.

SUGARBEET RESEARCH

1973 Report

Section B

Crops Research Laboratory, Logan, Utah

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Cooperation:

Utah Agricultural Experiment Station

The research was supported in part by funds provided through the Beet Sugar Development Foundation (Projects 17 and 27).

CONTENTS

SUMMARY OF RESEARCH ACCOMPLISHMENTS
Logan, Utah - 1973

J. C. Theurer, D. L. Doney, G. K. Ryser,
R. E. Wyse and D. L. Mumford

Variety Trials

Tests 1, 4 and 5. Seventeen new inbred pollinators were evaluated in replicated tests as inbreds and as male parents in single cross and 3-way hybrids. Neither the inbreds nor the hybrids showed significant yield, sugar percentage or purity compared to the check varieties.

Test 2. A comparison of top yielding varieties of 1971 and 1972 showed similar performance to that of previous years. Data confirmed that inbreds 0532, and L-53 were good parent lines for increasing yield and L-19 is a good parent for increasing sugar percentage.

Test 3. Ten single-cross hybrids and their reciprocals were evaluated in replicated trials at Logan. There were no significant differences between reciprocals for yield sugar percentage or quality factors.

Test 6. Twelve lines selected from crosses of divergent parentage were evaluated for future selection. Curly top was evident in all lines, however, in spite of this, two lines had excellent yield.

Tests 7 and 8. Selections from a number of heterogeneous populations, and crosses of these selections with several male sterile inbreds were evaluated for yield and sugar percentage as a guide to further selection. In general, selections that did poorly alone also exhibited poor population combining ability and vice versa. There were large differences among selections within populations.

Breeding and Genetic Studies

Viability studies of sugarbeet seed in long-term storage

After 45 years in cold storage, seed of the German variety, Braune, still retained 50% viability. Five other seedlots stored 35 years showed losses in viability from 2% to 66%. There was a significant correlation of the original germination percentage and the decrease in viability for these varieties.

Grafting studies with male sterile lines

Crosses were made with 15 male sterile segregates from the original CT5 inbred and SLC03 to confirm or disprove an apparent transfer of male sterility by grafting. Results suggest that the parental line may be

carrying CMS as well as genetic male sterility and that graft transmission of CMS did not occur in this line as previously supposed.

New sources of cytoplasmic male sterility

Fifteen new sources of male sterility were crossed to type O and pollen restorer inbred lines. Segregation of the progenies indicated that two sources were definitely genetic types. Seven sources were the same CMS as presently used in commercial hybrids. Two new male steriles segregated such to indicate they had different cytoplasm than the CMS presently used in sugarbeet hybrids. The other male steriles need additional study before they can be classified as different or equal to the presently known CMS.

Variation in genetic behavior of SLC 129 X 201 Rf vs NB-1 CMS X 201 Rf

Extensive study of segregating population of restorer crosses with SLC129 CMS and NB-1 CMS confirmed that NB-1 was a better emasculator line. Fertility in the NB-1 crosses could be explained by a single monogenic factor. However, the inheritance of fertility in SLC129 crosses was more complex. The average fertility for the F_2 generation was 62% and 31%, and for the BC_1 generation it was 59% and 8% for SLC129 and NB-1 crosses respectively.

Data indicated that plants having 90% stainable pollen, and good dehiscence were not genotypically the same. Generally, the segregation for fertility in sib crosses of MS X 90% F F_3 plants showed fertility segregation similar to that of the pollen parent.

Studies of variation in partial male-fertile populations

Plants of five annual partial-fertile populations were studied visually and microscopically for fertility. There was no association between the fertility of a plant and the place where seed was developed on the partial fertile seed parent. No specific differences in fertility variation were noted when flowers were pollinated with pollen produced in the same flower, compared with random pollination of a partial fertile plant.

Physiological Genetics

Mitochondrial Studies

An investigation into a probable cause for differing complementation results, revealed an effect due to a purification procedure. Isolating mitochondria through a .5M sucrose gradient gave cleaner preparations and more efficient mitochondria, but less complementation effects. This suggests that the complementation in earlier studies was perhaps complementation between broken or damaged mitochondria.

Helminthosporium maydis (corn leaf blight) toxin completely uncouples mitochondria from corn Texas cytoplasm but has little effect on mitochondria

of other corn cytoplasms. The effect of H. maydis toxin was studied on mitochondria from several sugarbeet cytoplasms. The toxin partially uncoupled sugarbeet mitochondria from all cytoplasms.

Biochemistry of CMS

A new hormone (Brassins) isolated from pollen of rape plants was tested on CMS flowers. The Brassins hormone had little if any effect on male sterility or fertility of sugarbeet.

The ph of normal developing anthers decreases from about 7:00 at early tetrad to about 5.2 at the early pollen stage after which there is a slight rise in pH. Anthers from CMS plants have a little delayed drop but of about the same extent as normal anthers and there is no rise in ph as maturity develops.

Isozyme patterns of esterase and peroxidase enzymes were studied in the leaves, petioles and roots of CMS and normal plants throughout the growing season. Patterns were different for the different tissue and changed during the growing season.

An esterase of normal anthers was found to be absent at certain stages of development in CMS anthers.

Genotypes with different sugar potential were all affected adversely for sugar percentage with increasing levels of nitrogen fertilizer. The high sugar genotype had approximately 2 percent more sugar than the low sugar genotype at each nitrogen level. Nitrate accumulation in the root at harvest time was about the same in the high sugar genotype as the low sugar genotype at each nitrogen level. This suggests an independence of genes affecting nitrogen accumulation from genes affecting sugar accumulation.

Genotypic competition in selection

Certain genotypes when grown together in mixed plots were found to complement each other, i. e., their mixed plot yield was significantly superior to their pure plot mean yield. Other genotypes in mixed plots yielded less than their pure plot means.

Factors affecting intergenotypic competition (competitive ability and competitive influence) were measured. Selections for these competitive factors were made to determine their importance in selection.

Plant Physiology

Postharvest respiration studies

There was a 3.5 fold range in respiration rate of sixty inbreds indicating ample genetic variability for efficient selection and breeding of improved storage varieties. The respiration rate of hybrids

showed a strong tendency to align with that of the lower respiring parent. There was no significant correlation between sucrose content or root size and respiration rate.

Fourteen growth regulating compounds were applied to sugarbeets four weeks before harvest. None of the chemicals significantly reduced respiration, but nine of the treatments had an adverse effect.

Imbibed seed respiration and seedling growth potential

A study was made to determine if imbibed seed respiration rates could be used to predict seedling vigor and subsequent yield potential of sugarbeet breeding lines. Results indicate that seedling vigor is a factor in determining final root yield. Seedling vigor is influenced by environmental conditions during seed development, maturity at harvest, and length of storage as well as the genetic make-up of the seed. Respiration measurements of imbibed seed are an index of seedling vigor but environmental conditions during the growing season greatly influence the relationship between seedling vigor and final yields. Therefore, imbibed seed respiration rates are not a good indicator of final root yield in sugarbeets.

Automated system for determining carbon dioxide gas exchange in plant materials

An automated system of CO_2 analysis is described which has proven to be an accurate and dependable research tool over one year of operation. This system is uniquely adapted for the measurement of respiratory gas exchange in sugarbeet roots, but is readily converted for use in other studies such as seed or whole plant respiration. The system is also designed for efficient coupling to a Burroughs 6700 computer for data reduction.

Plant Pathology

Curly top virus was purified and examined with an electron microscope. The virus is a very small spherical particle about 20 nanometers in diameter.

Good curly top infection was obtained in a disease nursery permitting an evaluation of approximately 2,000 rows for resistance to this disease.

ABSTRACTS OF PAPERS APPROVED FOR PUBLICATION

DONEY, D. L. and E. D. WHITNEY. Individual plant selection in nematode - infested soil. (Accepted for publication by J. Am. Soc Sugar Beet Technol).

Environmental variation was reduced in a nematode selection trial by space planting sugarbeets in uniformly mixed nematode-infested soil. Plants selected from this trial gave progeny that significantly outyielded the original population in both nematode-infested and nematode-free soil. This method of selection increased overall plant vigor.

JADHAU, S., D. K. SALUNKHE, R. E. WYSE, and R. R. DALVI. Solanum alkaloids: Biosynthesis and inhibition by chemicals. J. Food Sci. 38:453-455. 1973.

Incorporation of radioactive carbon from B-hydroxy-B-methylglutaric acid (HMG)-3-^{14}C, L-leucine-U-^{14}C, L-alanine-U-^{14}C, and D-glucose-^{14}C into the glycosidic steroidal alkaloids, solanine and chaconine of potato sprouts, was 9, 15, 24, and 20 times less than that of mevalonic acid (MVA)-2-^{14}C, respectively. The efficiency ratio revealed that HMG was incorporated via acetate or acetoacetate. The distribution of radioactivity originated from D-glucose-U-^{14}C was nearly 9 times higher in the glycoside moiety than that in the aglycone part of the glycoalkaloids. Apparently, Alar® (succinic acid, 2, 2-dimethylhydrazide), Ethrel® (2-chloroethylphosphonic acid) and Telone® (1, 3-dichloropropene and related halogenated hydrocarbons) significantly reduced the rate of incorporation of HMG into the alkaloids.

MUMFORD, D. L. Purification of curly top virus. 2nd International congress of Plant Pathology (Abstracts of papers). 1973.

Curly top virus was purified from tobacco (Nicotiana tabacum L.). Extracts were clarified with chloroform and butanol. The virus was concentrated either by precipitation with polyethylene glycol and NaCl or by ultrafiltration. Clarification virus was partially purified on sucrose density gradients. Further purification was accomplished by gel chromatography using agarose. Purified preparations had maximum ultraviolet light absorption at 260 nm and minimum at 240 nm and contained isometric particles ca 20 nm in diameter. The virus was followed through the purification procedure by a plant infectivity bioassay accomplished by allowing the insect vector to feed on infectious preparations.

MUMFORD, D. L. and G. D. GRIFFIN. Evaluation of systemic pesticides in controlling sugarbeet leafhopper. (Accepted for publication J. Amer. Soc. Sugar Beet Technol.).

Below-seed applications of aldicarb, carbofuran, and phorate produced over 85% leafhopper mortality within 5 days after emergence of treated sugarbeet seedlings. Aldicarb was highly effective for 3 weeks after planting, while carbofuran and phorate were effective for 6 weeks. With-

seed applications of aldicarb and side-dress applications of all three pesticides were less effective in killing leafhoppers than below-seed applications. All three pesticides prevented injury from flea beetle.

ROUNDY, T. E. and J. C. THEURER. Inheritance of a yellow-leaf mutant and a pollen fertility restorer in sugarbeet. (Accepted for publication Crop Science).

A yellow-leaf character in sugarbeet (Beta vulgaris L.) was conditioned by a single recessive gene. A monogenic factor, which restores partial fertility, was found in the material expressing the yellow-leaf mutant. Lingage tests showed independence of yellow leaf (yl) with monogerm (m), annual growth habit (B), and the restorer gene (Rf_3).

ROUNDY, T. E. and J. C. THEURER. Linkage and inheritance studies involving an annual pollen restorer and other genetic characters in Beta vulgaris L. (Accepted for publication Crop Science).

An annual pollen-restorer sugarbeet (Beta vulgaris L.) inbred, was studied to determine if a change from sterile to fertile cytoplasm had occurred. Data showed that the fertility expressed by the restorer inbred was the result of genetic factors and not cytoplasmic reversion. Linkage tests with the RF_2 gene showed independence with five other sugarbeet characters of the YRB (yellow root, red hypocotyl, annualness) group, m (monogerm), and vi_4 (virescens).

WYSE, R. E. and D. R. DILLEY. Evaluation of wax coatings for improved sugarbeet storage. Crop Sci. 13:567-570. 1973.

Wax coatings were beneficial in reducing respiration rates under conditions where rates were high and gaseous diffusion became a dominant factor in regulating respiration rates.

Wax coatings sprayed on surface beets and then covered with straw may be a beneficial combination to prevent desiccation on the surface of commercial storage piles and thus reduce sucrose losses.

WYSE, R. E. Storage of sugarbeet in controlled atmospheres to reduce postharvest losses. Crop Sci. 13:701-704. 1973.

Storage of sugarbeet roots in atmospheres containing 5% O_2 significantly reduced sucrose losses over storage in air. Increasing carbon dioxide to 10% had no effect. These results indicate that it is possible to reduce sucrose losses in commercial piles by lowering oxygen levels to 5%. The recent increased use of plastic coverings and the technique of recycling pile air could be readily adapted to incorporated maintenance of reduced O_2 atmospheres.

WYSE, ROGER. Influence of cultural practices and storage conditions on

quality losses during storage. Proc. Beet Sugar Devel. Found. Conf. on Sugarbeet Storage 1973.

The paper reviews the research results of the author and others on the effect of cultural practices before harvest and storage conditions on quality deterioration during the storage of sugarbeet roots prior to processing. Important cultural factors are crown removal and variety. During storage, high temperature and desiccation are the primary causes of quality losses.

Variety Tests, Logan and Farmington, Utah, 1973

J. C. Theurer, D. L. Doney
G. K. Ryser, and R. E. Wyse

SOIL TYPES: North Farm: Silty Loam. Farmington Farm: Sandy Loam.

PREVIOUS CROPS:

North Farm: 1971 - grain, 1972 fallowed.
Farmington Farm: 1971-1972 fallowed.

FERTILIZER:

North Farm: 300 pounds of 34-0-0 and 320 pounds 0-45-0 per acre.

Farmington Farm: 640 pounds of 16-20-0 per acre.

PLANTING DATES:

North Farm: May 15, 1973. Farmington Farm: April 26, 1973 (All tests at both farms were planted in 2-row plots 37 feet long)

THINNING DATES:

North Farm: June 12-14, 1973. Farmington Farm: May 28, 29, 1973.

IRRIGATIONS:

North Farm: Sprinkled after planting, after thinning, and on a weekly schedule until 2 weeks before harvest.

Farmington Farm: Furrow irrigated on weekly schedule.

HARVEST DATES AND PROCEDURES:

North Farm: October 12-15 and 16, 1973.

Farmington Farm: October 29 to November 1, 1973.

Tops were beat once with a rotobeater then topped and harvested with a two row harvester. All beets in plot were counted into the weighing basket on the harvester. Two ten-beet samples were selected at random from each plot for sugar analysis and all beets in the plot were weighed to determine root yield

TEST 1

Forty-three single cross hybrids, derived by crossing 17 new inbreds with seven male sterile lines, were evaluated to determine the performance of the pollinator inbreds at Logan, Utah. Four commercial varieties were included in the tests as check plots. The 47 entries were planted in five replications.

Ov X 72505 was the entry with the highest tonnage and 133 X 72508 gave the best sugar percentage (Table 1). AI-1 X 72504, and 133 X 72517 showed the best quality. None of the hybrids showed significance over the best check variety for any of the factors that were measured.

There was no apparent general combining ability for any of the pollinator inbreds in the test for yield, sugar percentage or index. Based on this test, these inbreds show little promise for use as pollinators in the production of commercial hybrids.

TEST 2

The top yielding varieties in 1971 and 1972 were tested again in 1973 in a randomized block experiment of 6 replications with Tasco #3 and UI Hybrid #D as checks.

Hybrid A7113 X 0532, the second highest yielding variety in 1972, was the highest yielding variety at Farmington in 1973, but it was not significantly better than the Tasco #3 check variety this year. (Table 2a).

Varieties having L-19 as a parent again showed significantly greater sugar percentage than check varieties.

Hybrids with L-37 were average in sugar percentage and above average in yield, but were not significantly different from the check varieties in either characteristic. The two check varieties had the lowest impurity index.

At Logan, L-53 X 0532 and A7113 X 0532 were high yielding entries as they were last year, and L-53 X 0532 was significantly better than the check varieties for yield (Table 2b). Hybrids with L-19 parentage were consistent in showing good general combining ability for sugar percentage. Hybrids with 0529 as a parent also had a higher sugar percentage than the check varieties, which agrees with 1972 data.

The high yielding varieties with 0532 pollen parent had significantly high impurity indices. The check variety Tasco #3 had the best impurity index which was due to low nitrogen and potassium content. L-19 hybrids were low in nitrogen and L-37 hybrids were low in sodium. Comparison of performance at the two locations showed no significant variety by location interaction.

TEST 3

This study was established to compare the performance of 10 single cross CMS hybrids and their reciprocal crosses. However, poor emergence for 4 of the hybrids necessitated dropping these entries out of the experiment. Entries were planted in six replicates.

The single cross 129 X L-53 was highest in yield and 133 X 129 was the lowest yielding entry (Table 3a). Inbred L-53 showed general combining ability for yield. Hybrids with AI-10 parentage were highest in sugar percentage and also showed lower average impurity indices.

Differences between seven pairs of reciprocal crosses are shown in Table 3b. There were significant differences among hybrids of different parentage. However, there were no significant differences between reciprocal crosses for any of the measured factors. These results did not confirm data of a previous year that indicated that some inbreds gave better performance in hybrids as a male parent and others as a female parent.

TEST 4

Seventeen new inbreds which were used as pollinators in Tests 1 and 5 were compared with one high yield and two high sugar inbred checks. The 20 entries were planted in a 4 replicate experiment.

Two of the new inbreds were equal to the CT9 high yield check for tons of beets, and 10 inbreds were significantly lower in yield than this check (Table 4).

The L-19 high sugar check was higher in sugar percentage than any other inbred and was significantly superior to all of the new inbreds for this characteristic. Ov-1 high sugar check was significantly better in sugar percentage than 12 new inbreds. Inbred 72514 was the only new inbred showing high sugar percentage, and it was the fourth lowest inbred in tonnage.

The three inbred checks also showed low impurity indices. Inbred 72517 had the best index value of the new inbreds mainly due to low nitrogen and sodium constituents. Inbreds 72507, 72508, 72512 and 72513 were also low in sodium while 72503, 72508, and 72516 were lowest in potassium.

TEST 5

Evaluation of New 3-Way Hybrids

Forty-six new 3-way hybrids were tested at Farmington, Utah, in

randomized blocks with six replications. Six check varieties were included in this test, UI hybrids #C, #D, and #F, Tasco hybrid #1 and #3 and US22/2. The first fourteen hybrids listed show no significant difference in gross sugar. These fourteen hybrids include four of the six check varieties in the test. UI hybrid #F was highest in gross sugar, next to the highest in tons per acre, and just under the average of the test in sugar percentage. Three new hybrids (K-53 X FC506) X 72515, (AI-10 X FC601) X 72502 and (FC506 X FC601) X 72507, had gross sugar yield above UI hybrid #C and Tasco hybrid #3, but were not significantly higher in sugar percentage.

Hybrids with 72513 and 72508 as male parents averaged the highest sugar percentage. The best hybrids in the test for this character were crosses (AI-10 X FC601) X 72513 and (AI-10 X FC601) X 72508.

On the average hybrids with 72507 and 72508 had the lowest impurity indices. There were no significant differences among the entries for nitrogen. Crosses with 72507 had the lowest sodium and potassium content.

TEST 6

The lines tested in this trial were selected from crosses involving wide differences in parentage. Four lines had very poor stands and gave poor yields (Table 6). Since these lines came from different gene pools, there was very little curly top resistance in most of the lines. Curly top infection was noted in all lines except the check entries (numbers 3 & 4, Table 6). Lines 1, 6, 11 and 13 had the most severe curly top infection. Lines 1 and 11 yielded well in spite of the curly top infection. All lines were quite high in nitrogen and impurity index. Several lines will be chosen for future selection to improve the quality factors and curly top resistance.

TESTS 7 AND 8

Tests 7 and 8 involved some of the same material. Test 7 (Table 7), contained a series of selections from a number of heterogeneous populations. In Test 8, (Table 8), the selections from each population were bulked and crossed to a number of CMS lines to gain an estimate of the combining ability on a population basis. Two commercial checks were used in each test. In general, the selections that did poor in Test 7, also exhibited a poor population combining ability and vice versa. Populations AN093-1 and AN094-1 showed good combining ability for yield, (Table 8). There were big differences among selections within populations, (Table 7). The selections were generally lower in sugar and higher in impurity than the commercial check hybrids, (Table 7). This was to be expected because of the lack of selection pressure on the impurity factors. These two tests give insight into which direction future selection should proceed.

Table 1. New Single Cross Hybrids (47 entries, 5 reps) North Farm, Logan, Utah, 1973

Code	Description	Acre Yield		Percent					Beet
		Gross Sugar	Tons Beets	Sugar	Index	N	Na	K	Count
108	OVX72505	8,789	30.49	14.50	930	580	156	2,854	60
107	AI-1X72504	8,733	27.37	15.97	556	373	89	1,921	70
123	A7113X72509	8,660	27.48	15.76	705	483	120	2,341	74
116	L-53X72507	8,591	28.11	15.29	796	574	104	2,407	74
127	L-53X72512	8,340	26.53	15.72	753	518	105	2,506	64
133	OVX72514	8,308	28.49	14.57	979	604	213	2,927	56
105	L-53X72504	8,238	27.48	14.99	685	411	110	2,290	69
109	L-53X72505	8,182	26.74	15.17	749	543	125	2,158	58
147	Tasco Hybrid #3	8,176	26.46	15.50	691	433	112	2,350	74
134	L-53X72514	8,168	25.69	15.85	739	517	118	2,441	61
113	A7113X72506	8,146	25.76	15.88	666	406	133	2,382	58
124	AI-1X72509	8,090	26.14	15.48	695	513	96	2,123	77
135	OVX72515	8,034	26.32	15.28	698	524	153	1,945	66
146	Tasco Hybrid #1	8,019	25.79	15.57	568	399	97	1,795	68
104	L-53X72503	7,898	26.43	14.94	835	603	126	2,373	68
122	L-53X72509	7,896	25.83	15.30	765	527	131	2,377	58
102	133X72502	7,874	25.62	15.32	740	516	116	2,300	50
145	U.I. Hybrid #D	7,815	25.40	15.49	689	521	96	2,018	67
118	L-53X72508	7,799	24.82	15.72	687	504	108	2,148	71
144	U.I. Hybrid #B	7,756	25.48	15.23	746	552	123	2,153	66
131	A7113X72513	7,699	23.87	16.14	728	584	101	2,210	65
130	L-53X72513	7,677	25.38	15.12	803	560	119	2,446	55
103	L-53X72502	7,612	24.71	15.54	755	539	118	2,285	51
125	L-53X72510	7,602	24.57	15.44	714	546	150	2,017	64

Table 1. (continued)

Code	Description	Acre Yield: Gross Sugar	Acre Yield: Tons Beets	Acre Yield: Percent Sugar	PPM: Index	PPM: N	PPM: Na	PPM: K	Beet Count
112	0VX72506	7,490	26.22	14.24	953	589	136	2,784	52
115	0VX72507	7,252	25.38	15.15	967	618	126	2,794	52
110	A1-12X72505	7,238	23.87	15.16	739	467	109	2,456	59
138	L-53X72516	7,227	23.66	15.31	600	376	129	1,975	71
141	L-53X72517	7,115	23.17	15.30	675	405	119	2,354	59
114	128X72507	7,112	22.82	15.53	689	491	96	2,135	49
137	133X72516	7,096	23.17	15.27	698	486	131	2,115	48
136	A7113X72515	6,921	21.98	15.74	682	492	130	2,138	57
140	133X72517	6,908	22.68	15.28	628	442	88	1,928	54
139	A1-1X72516	6,889	22.47	15.31	653	471	127	1,937	62
128	A1-1X72512	6,859	26.53	16.75	598	404	99	2,014	55
142	A7113X72517	6,743	21.49	15.76	595	349	109	2,169	48
106	A7113X72504	6,715	21.70	15.50	639	397	110	2,212	53
119	A7113X72508	6,530	21.25	15.24	795	611	126	2,212	58
120	A1-1X72508	6,277	20.76	15.07	882	748	110	2,172	58
126	133X72512	6,020	19.60	15.44	768	529	112	2,400	30
121	133X72509	6,019	19.32	15.59	756	602	102	2,157	49
132	A1-1X72513	5,992	19.53	15.38	755	547	103	2,217	49
101	L-53X72501	5,945	19.53	15.27	806	540	105	2,588	37
129	133X72513	5,903	18.27	16.17	669	531	92	2,056	41
143	A1-1X72517	5,733	18.06	15.87	666	471	101	2,172	40
117	133X72508	5,443	16.66	16.25	624	515	98	1,842	43
111	133X72506	4,845	16.59	14.75	795	555	135	2,263	36
Mean of all Varieties		7,327	23.85	15.39	730	509	117	2,252	58
Standard Error		1,162	3.65	.71	132	108	32.49	303	11
LSD (5% Point)		1,447	4.60	.88	164	134	40	377	6.73
CV		15.86	15.32	4.59	18.04	21.21	27.70	13.44	18.44
Calculated F		3.31**	3.93**	2.03**	2.82**	2.67**	2.25**	3.57**	5.25**

** Significant at 1% level

Table 2a . Repeat test of 1971 and 1972 Top Varieties, Farmington, Utah. (15 entries, 6 Reps)

Code	Description	Acre Yield: Gross Sugar	Acre Yield: Tons Beets	Percent Sugar	PPM: Index	PPM: N	PPM: Na	PPM: K	Beet Count
202	A7113X0532	8,504	23.68	17.99	531	355	116	2,225	58
214	Tasco Hybrid #3	8,324	23.25	17.90	321	162	112	1,491	55
212	7114XL-37	7,921	21.32	18.58	323	156	102	1,628	55
205	(133XCT5)XL-37	7,750	20.77	18.67	462	405	80	1,697	55
211	(129X0V2)XL-37	7,714	20.88	18.47	355	193	106	1,700	50
210	(129X0V2)XL-19	7,636	19.54	19.56	345	261	91	1,523	54
204	(S33XNB1)XL-37	7,566	20.65	18.33	396	274	86	1,668	52
201	L-53X0532	7,536	21.12	17.88	513	387	122	1,934	53
209	(133XCT5)XL-19	7,514	19.36	19.43	366	255	105	1,671	51
203	L-53X0529	7,303	19.19	19.00	353	258	99	1,503	57
208	(S33XNB1)XL-19	6,907	18.38	18.79	385	239	91	1,789	41
215	UI Hybrid #D	6,960	19.13	18.18	318	190	131	1,373	42
213	A7113X0529	6,856	18.35	18.66	375	264	116	1,569	52
207	(S33XNB1)X27.53	6,730	18.67	18.02	332	182	119	1,486	33
206	L-53XL-19	5,493	14.96	18.37	330	235	109	1,320	27
Mean of all Varieties		7,381	19.95	18.52	380	255	106	1,639	49
Standard Error		1,216	3.26	.48	62	90	29	122	10
LSD 5% Point		1,404	3.70	.56	72	104	NS	140	11
C. V. Percent		16.48	16.33	2.57	16.46	35.26	27.08	7.42	20.10
Calculated F		2.17*	2.56**	7.09**	7.17**	4.40**	NS	20.75**	5.07**

* Significant at 5%
** Significant at 1%

Table 2b . Repeat test of 1971 and 1972 Top Varieties, North Farm Logan, Utah, 1973.(15 Entries, 4 Reps)

Code	Description	Acre Yield Gross Sugar	Acre Yield Tons Beets	Percent Sugar	PPM Index	PPM N	PPM Na	PPM K	Beet Count
201	L53XO532	8,708	29.31	14.84	971	681	173	2,790	65
202	A7113XO532	8,369	28.18	14.85	908	604	176	2,701	70
203	L53XO529	7,832	25.11	15.51	749	534	147	2,292	72
205	(133XCT5)XL-37	7,585	24.50	15.40	863	659	89	2,527	66
213	A7113XO529	7,147	22.75	15.69	797	583	130	2,467	64
211	(129XOV2)XL-37	7,090	24.68	14.29	777	414	124	2,514	70
214	Tasco Hybrid #3	7,018	23.67	14.75	615	363	128	1,959	72
215	UI&Hybrid #D	6,898	23.45	14.68	752	510	119	2,178	59
209	(133XCT5)XL-19	6,890	21.88	15.60	690	425	145	2,344	58
210	(129XOV2)XL-19	6,796	21.48	15.86	683	478	123	2,200	57
204	(S33XNBI)XL-37	6,744	22.05	15.31	922	753	93	2,486	54
212	7114XL-37	6,721	22.49	14.98	709	506	110	2,056	61
208	(S33XNB-1)XL19	6,581	21.44	15.34	781	522	129	2,380	54
207	(S33XNB-1)X27.53	6,104	21.88	13.94	718	386	139	2,260	45
206	L-53XL-19	5,739	18.99	14.95	778	562	116	2,156	46
Mean of all Varieties		7,082	23.46	15.07	781	532	130	2,354	61
Standard Error		1,129	3.45	0.69	128	103	29	332	10
LSD (5% Point)		1,710	5.22	1.05	193	156	45	503	15
C.V. Percent		15.96	14.71	4.60	16.36	19.41	22.70	14.11	16.03
Calculated F		1.91*	2.36*	2.38*	2.36*	4.69*	2.69**	1.93*	3.22**

* Significant at 5% level
** Significant at 1% level

Table 3a . Reciprocal Diallel - North Farm, Logan, Utah. 1973. (16 Entries, 6 Reps)

New Code	Description	Acre Yield: Gross Sugar	Acre Yield: Tons Beets	Percent Sugar	PPM: Index	PPM: N	PPM: Na	PPM: K	Beet Count
313	129 X L-53	8,522	28.41	14.98	709	454	172	2,138	68
307	153 X 133	8,308	27.83	13.93	762	535	158	2,161	73
310	129 X FC 504	7,963	26.95	14.87	748	456	201	2,330	70
316	F6504 X L-53	7,692	25.65	14.85	860	498	260	2,676	66
314	133 X L-53	7,590	24.62	15.42	701	473	203	2,129	50
304	L-53 X 129	7,676	26.83	14.26	762	480	164	2,148	64
302	AI-10 X 129	7,242	23.21	15.56	709	518	129	2,136	62
303	FC 504 X 129	7,024	23.19	15.16	717	444	161	2,327	67
309	L-53 X AI-10	7,020	22.10	15.84	657	518	103	1,939	70
312	L-53 X FC 504	7,008	23.22	15.13	746	465	172	2,376	67
308	129 X AI-10	6,991	22.28	15.62	638	431	104	2,124	61
315	AI-10 X L-53	6,796	21.47	15.87	736	599	138	2,065	64
306	AI-10 X 133	6,805	21.47	15.89	707	527	110	2,152	70
311	AI-10 X F6504	6,467	21.06	15.28	707	440	136	2,288	51
305	129 X 133	6,398	22.34	14.37	824	546	149	2,312	57
301	133 X 129	5,533	19.48	14.11	870	530	145	2,548	48
Mean of all Varieties		7,190	23.76	15.13	741	495	157	2,241	63
Standard Error		1,083	3.61	.72	125	101	28	322	10.13
LSD (5% Point)		1,412	4.18	.89	NS	NS	35	396	13
C. V. Percent		15.06	15.21	4.76	16.84	20.39	17.87	14.37	16.09
Calculated F		2.93**	3.24**	3.60**	NS	NS	12.66**	1.99	3.49*

* Significant at 5% level
** Significant at 1% level

Table 3b . Reciprocal Diallel, North Farm, Logan, Utah, 1973 (14 Entries 6 reps)

Code	Description	Acre Yield Gross Sugar	Tons Beets	Percentage Sugar	PPM Index	N	Na	K	Beet Count
305	129 X 133	6,398	22.34	14.37	824	546	149	2,312	57
301	133 X 129	5,533	19.48	14.11	871	530	145	2,548	48
	Difference	865	2.86	.36	47	16	4	236	9
302	AI-10X129	7,242	23.27	15.56	709	518	129	2,136	62
308	129 X AI-10	6,991	22.28	15.62	638	431	104	2,124	61
	Difference	251	.99	.60	71	87	25	12	1
310	129XFC504	7,963	26.95	14.87	748	457	199	2,330	70
303	FC504X129	7,024	23.19	15.16	717	444	161	2,327	67
	Difference	939	3.76	.29	31	13	38	3	3
313	129XL53	8,522	28.41	14.98	709	454	172	2,138	68
304	L-53X129	7,676	26.83	14.26	762	480	164	2,148	64
	Difference	864	1.58	.72	53	26	8	10	4
307	L-53X133	8,308	27.83	14.93	762	535	158	2,161	73
314	133XL-53	7,590	24.62	15.42	701	473	203	2,129	50
	Difference	718	3.21	.49	61	62	45	32	23
316	FC504XL-53	7,692	25.65	14.85	860	498	260	2,676	66
312	L-53XFC504	7,008	23.22	15.13	746	465	172	2,376	67
	Difference	684	2.43	.28	114	33	88	300	1
309	L-53XAI-10	7,020	22.11	15.84	657	518	103	1,939	70
315	AI-10XL-53	6,796	21.47	15.86	734	599	130	2,065	64
	Difference	224	.64	.02	77	81	27	126	6
Mean of all Varieties		7,269	24.12	15.07	746	489	161	2,222	63
Standard Error		1,118	3.69	.70	124	101	28	322	10
LSD (5% Point)		1,298	4.26	.81	NS	NS	35	396	13
C.V. Percent		15.39	15.31	4.62	16.48	20.20	17.86	14.36	1,609
Calculated F		2.89**	3.10**	3.89**	NS	NS	12.65**	1.99*	3.45**

* Significant at 5% level ** Significant at 1% level

Table 4. New inbreds North Farm, Logan, Utah, 1973. (20 entries, 4 Reps)

Code	Description	Acre Yield		Percent	PPM				Beet
		Gross Sugar	Tons Beets	Sugar	Index	N	Na	K	Count
418	CT9 High Yield	5,409	18.03	14.98	677	478	184	1,879	51
404	72504	5,377	19.16	14.00	772	447	154	2,327	62
402	72502	4,967	18.11	13.71	786	495	139	2,080	56
419	L-19 High Sugar	4,951	15.14	16.35	661	565	129	1,855	54
409	72509	4,673	16.19	14.38	934	730	134	2,211	56
405	72505	4,518	16.45	13.69	755	441	141	2,142	58
403	72503	4,382	14.53	15.08	675	531	158	1,726	51
415	72515	5,107	14.18	14.26	689	425	172	1,916	57
401	72501	4,083	14.92	13.66	848	593	196	1,956	37
407	72507	3,852	14.04	13.68	784	556	106	1,918	46
416	72516	3,837	13.61	13.88	709	454	214	1,818	47
413	72513	3,825	13.21	14.88	716	551	99	1,882	51
408	72508	3,787	12.69	15.06	746	634	84	1,832	55
414	72514	3,766	12.25	15.28	811	597	158	2,327	36
420	OV-1 High Sugar	3,719	11.73	15.88	563	456	66	1,658	55
406	72506	3,701	13.13	13.99	691	396	135	2,065	58
411	72511	3,519	12.64	13.95	744	524	117	1,883	49
417	72517	3,179	10.85	14.59	601	295	103	2,186	42
412	72512	3,449	12.08	14.27	752	517	102	2,051	39
410	72510	2,646	9.01	14.65	758	567	180	1,915	26
Mean of all varieties		4,091	14.10	14.51	734	513	139	1,982	49
Standard Error		871	2.88	.74	123	108	48	299	8
LSD 5% Point		1,286	4.22	1.09	182	160	71	NS	12
C.V. Percent		21.30	20.45	5.08	16.76	21.04	34.61	15.06	16.06
Calculated F		2.77**	3.15**	4.21**	1.82*	3.08**	2.61**	NS	5.24**

* Significant at 5% Point
** Significant at 1% Point

Table 5 . New 3-Way Hybrids, Farmington, Utah, 1973. (46 entries 6 reps)

Code	Description	Acre Yield Gross Sugar	Acre Yield Tons Beets	Percent Sugar	PPM Index	PPM N	PPM Na	PPM K	Beet Count
543	UI Hybrid #F	9,370	26.31	17.83	368	227	194	1,431	62
533	(L-53XFC506) X72515	9,068	26.34	17.25	364	178	198	1,511	58
502	(A1-10XFC601)X72502	9,013	25.08	18.00	373	225	164	1,547	54
518	(FC506XFC601)X72507	8,940	25.32	17.66	305	172	97	1,332	57
542	U.I.Hybrid #C	8,625	24.62	17.54	376	209	269	1,416	51
528	(L-53XFC506)X72512	8,605	24.41	17.65	364	213	138	1,527	64
546	Tasco Hybrid #3	8,558	24.21	17.68	338	170	163	1,474	60
532	(L-53XFC506)X72513	8,533	23.57	18.21	370	227	150	1,572	54
504	(FC506XFC601)X72502	8,513	24.27	17.60	377	195	236	1,533	54
509	(FC506XFC601)X72504	8,493	23.57	18.03	333	162	143	1,556	50
544	U.I. Hybrid #D	8,424	23.68	17.79	347	218	180	1,346	54
520	(A1-1XFC506)X72508	8,318	22.75	18.26	351	214	186	1,439	60
535	(A1-10XFC601)X72516	8,304	23.28	17.83	333	183	157	1,422	56
511	(L-53XFC506)X72505	8,296	23.68	17.53	390	206	234	1,579	51
508	(L-53XFC506)X72504	8,264	24.44	16.91	404	204	233	1,586	58
512	(A1-1XFC506)X72505	8,211	23.39	17.57	359	191	173	1,500	54
514	(L-53XFC506)X72506	8,173	22.98	17.83	368	178	193	1,639	51
501	(L-53XFC506)X72501	8,141	23.30	17.50	326	175	134	1,400	52
516	(A1-10XFC601)X72507	8,004	21.76	18.38	287	166	96	1,311	56
529	(FC506XFC601)X72512	7,965	22.40	17.79	354	173	107	1,677	46
545	Tasco Hybrid #1	7,950	22.63	17.64	337	183	136	1,456	58
525	(L53XFC506)X72510	7,899	21.29	18.55	373	232	209	1,548	42
517	(A1-1XFC506)X72507	7,868	21.88	18.01	307	181	115	1,322	59
541	US2/2	7,775	22.17	17.56	404	230	251	1,562	57
534	(FC506XFC601)X72515	7,766	21.29	18.23	305	151	111	1,462	39

Table 6. Test 6 = Evaluation of lines selected from crosses of divergent parentage.

Code	Description	Acre Yield		Percent Sugar	Index	PPM		
		Gross Sugar	Tons Beets			N	Na	K
1	AD057-3B	7,245	23.56	15.4	744	544	162	2,150
2	AD058-2B	6,367	21.23	14.9	783	599	76	2,168
3	A7203 (U&I #F)	7,938	24.79	16.0	619	478	92	1,793
4	A069 (Tasco AH3)	7,125	22.98	15.5	550	368	80	1,820
5	AD057-1B	6,861	22.66	15.2	796	607	129	2,191
6	AD034-2A*	3,650	12.60	14.6	846	583	159	2,385
7	AD024-2A	7,376	23.22	15.8	624	449	129	1,964
8	AD012-1A	6,957	22.58	15.5	710	517	112	2,157
9	AD023-1A	6,894	23.45	14.7	730	507	164	2,035
10	AD024-1A*	2,893	9.98	14.4	779	482	178	2,304
11	AD034-1A	6,733	22.40	15.0	764	518	119	2,336
12	AD034-3A*	3,639	12.95	14.1	951	632	167	2,545
13	AD034-4A*	2,521	8.40	14.8	763	454	190	2,376
14	AD057-2B	6,548	20.65	15.9	687	455	135	2,263
15	A110	7,152	23.45	15.3	544	345	96	1,822
LSD		629	1.90	.61	158	171	29	242
C. V. Percent		7.13	6.6	3.21	19.05	27.96	23.07	9.95

* Poor Stand

Table 7 . Test 7 = Evaluation of selected lines.

Code	Description	Acre Yield		Percent	Index	PPM		
		Gross Sugar	Tons Beets	Sugar		N	Na	K
b73	AN094-1 X other AN094-1's	8,372	23.98	17.5	510	282	451	1,811
b74	AN094-1a X other AN094-1a's	7,961	22.72	17.5	549	320	358	2,060
b76	AN094-1b X other AN094-1b's	7,796	23.63	16.5	572	294	496	1,903
b77	AN013-2(38-2-2) X other AN013-2's	5,591	16.83	16.6	597	372	376	1,950
b79	AN013-2(44-312)X other AN013-2's	5,786	17.76	16.3	597	365	353	1,927
b80	AN013-2(44-314 X other AN013-2's	5,010	16.01	15.7	622	336	444	1,912
b82	AN073(36-23) X other AN073's	7,021	20.65	17.0	451	285	280	1,530
b84	AN073(41-25) X other AN073's	7,060	21.38	16.5	454	232	326	1,622
b86	AN073(43-616) X other AN073's	5,187	14.79	17.6	374	225	229	1,399
b93	AN014-1(45-53) X other AN014-1's	4,582	13.15	17.4	436	274	407	1,367
b94	AN093-1(38-413) X other AN093-1's	4,212	13.33	15.8	615	288	547	1,969
b95	AN093-1(38-416) X other AN093-1's	7,412	21.99	16.8	560	287	538	1,879
b96	AN093-1(38-42) X other AN093-1's	8,149	25.14	16.2	563	291	529	1,738
b98	AN093-1(41-14) X other AN093-1's	7,636	24.10	15.8	606	273	627	1,871
b103	AN013-1(39-36) X Misc.	6,311	19.83	15.9	605	324	426	1,931
b107	AN039-1 X Misc.	6,663	20.07	16.6	581	337	425	1,918
b108	AN039(38-67) X Misc.	6,713	20.48	16.4	579	336	389	1,921
b109	AN047(41-66) X Misc.	8,102	25.20	16.1	522	216	389	1,952
b110	AN039(39-214) X Misc.	8,019	25.03	16.1	584	294	449	1,955
b111	AN047(41-613) X Misc.	7,053	20.91	16.9	504	297	311	1,788
A7203	U&I #F	9,478	26.95	17.6	372	254	195	1,325
A069	Tasco AH3	7,667	21.00	18.3	339	197	157	1,465
Mean of all varieties		6,899	20.68	16.7	528	290	396	1,782
L.S.D.		103	3.18	.7	86	93	121	175
C. V. Percent		13.30	13.59	3.51	14.38	28.3116	26.77	8.63

Table 8 . Test 8 = combining ability of selected populations.

Code	Description	Acre Yield: Gross Sugar	Acre Yield: Tons Beets	Percent Sugar	Index	PPM: N	PPM: Na	PPM: K
b51	0180 CMS X AN013-2	7,734	22.81	16.9	440	224	188	1,824
b52	0180 CMS X AN073	7,627	21.88	17.4	393	224	196	1,546
b58	809 CMS X AN013-2	6,627	19.89	16.6	504	243	259	2,003
b60	809 CMS X AN093-1	6,755	20.04	16.8	494	239	349	1,883
b62	A923 X AN073	7,263	20.18	17.9	380	201	160	1,704
b64	A7113 X AN013-2	7,046	20.18	17.5	480	270	243	1,925
b65	A7113 X AN073	7,342	20.65	17.8	394	246	164	1,584
b67	953 CMS X AN013-2	6,476	18.58	17.4	421	252	196	1,651
b68	953 CMS X AN073	7,957	21.96	18.1	370	207	221	1,533
b69	953 CMS X AN093-1	8,332	23.83	17.5	420	206	257	1,750
b70	953 CMS X AN094-1	7,649	21.93	17.5	483	298	259	1,797
b54	833 CMS X AN013-2	4,473	13.56	16.7	615	366	380	2,083
A7203	U&I #F	7,217	20.27	17.8	348	216	148	1,401
A069	Tasco AH 3	6,501	18.05	18.0	319	178	100	1,446
b55	833 CMS X AN073	5,655	15.75	17.9	376	178	264	1,622
b61	A923 X AN013-2	6,777	19.08	17.7	475	255	183	2,095
11158	L-53 CMS X 0529	7,375	19.54	18.8	386	288	145	1,847
Mean of all varieties		7,279	20.70	17.6	417	236	207	1,686
L.S.D. (5% point)		884.8	2.44	.7	63	74	53	174
C. V. Percent		10.53	10.21	3.43	13.18	27.54	22.50	8.94

BREEDING AND GENETICS

A. Viability Studies of Sugarbeet Seed in Long-term Storage

A long-term seed storage experiment was initiated by Dr. Dean A. Pack on March 8, 1928, and a preliminary report published in 1950.[1/] Two 5-pound sugar beet seed samples of the German variety Braune, reproduced at St. George, Utah, in 1927, were used in the experiment. This seed was run over a 7/64 inch screen to eliminate small and most likely unfilled seedballs. The seed was placed originally in two metal containers, one of which was sealed. These containers were stored in a commercial cold-storage plant at temperatures ranging from +10 F to -10 F. By 1938, the containers rusted and became perforated and the seed was transferred to cloth bags. July 3, 1942, the seed samples were transferred to storage where temperatures were maintained rather constantly at 0 F combined with very low humidity. July 1, 1961, the seed samples were transferred to a chest freezer unit at the present sugar beet investigations facility at Logan, Utah. The chest freezer unit was maintained at 0 F to -10 F. Part of the seed at this time was sealed in glass jars and the remainder was stored in cloth bags for a comparable study at cold temperatures.

On May 17, 1938, another seed-storage experiment was begun in a cold-storage plant at Salt Lake City at 0 F temperature with five curly-top-resistant varieties of sugar beets. On July 1, 1961, the cold storage seed samples were transferred to a chest freezer unit at the present sugar beet investigations facility at Logan, Utah. The temperature of the freezer unit was maintained at 0 to -10 F. Part of the seed of each variety was at this time sealed in glass jars and the remainder was stored in cloth bags for a comparable study.

The year 1973, marked 45 years of storage for the Braune variety and 35 years for the seed storage study initiated in 1928.

This year we ran a standard germination test on these varieties. Three replicates of 100 seeds from each of two seed lots of Braune and from the cloth bag and glass jar seed lots of US#1, US#33, US#22, US#15, and US#12, were germinated on Kimpak germination paper in a germination chamber. Germination counts were made at 4, 7, 10, and 14 day intervals.

The average germination percent for the Braune variety was 37.5% for the cloth bag sample and 42.6% for the glass jar (Table 1). There was no difference between the methods of seed storage. After 45 years, the germination percentage has been reduced only 50%.

Germination percentage for the five other varieties in long term seed storage are given in Table 1a. Seed stored in the glass jars had slightly higher but non-significantly different germination percentages than those stored in cloth bags.

There was a marked difference between the varieties in the loss of ability to germinate. The variety US#33 had only 2% decrease while US#15 showed a 66% decrease in germination percent. There was no relationship of the date seed was harvested with the decrease in germinability. However, there was a significant correlation (r=.89) for the original germination percentage and the decrease in germination percentage. Varieties with high original germinability tended to retain their high germination percentage while varieties originally with low germinability suffered a greater loss in seed viability.

1/ Pack, D. A. and F. V. Owen. 1950. Proc. Am. Soc. Sugarbeet Technol. 6:127-129.

B. Grafting Studies with Cytoplasmic Male Sterile Lines

Seedling seedstalk and plug grafts with several sources of material have been made in combinations of CMS scion/fertile stock, CMS/CMS, F/CMS and F/F. In early studies with SLC03 and SLC03 CMS and 4-5 other lines, fertility remained autonomous to the fertility of the respective scion. In one case, a CT5 line produced male sterile plants, which were expected, because Dr. F. V. Owen had classified this line as a carrier of a genetic male sterility. However, four progenies of MS (from CTS grafts) crossed with the SLC03 annual type O pollinator gave mostly male sterile offspring.

1964 Research Report, p. 68-76
1966 Research Report, p. 172-176

Backcrossing male sterile plants to the annual pollinator SLC03 resulted in a good CMS inbred. These results indicated one of the following:

(1) Cytoplasmic male sterility was transmitted across a graft union in this plant material.

(2) There is an association between the a_1 gene and genetic factors conditioning cytoplasmic male sterility.

(3) The original CT5 line contained sterile plasm that was not recognized by Dr. Owen.

In 1973, we made crosses between 15 male sterile segregates from the original parental line of CT5 and SLC03. F_1 crosses were evaluated in the greenhouse.

In eleven lines all plantswere fertile as expected for genetic type of male sterility. However, four lines segregated 5F:2MS, 6F:1MS, 18F:2MS and 17F:2MS. These results suggest that the parental line may be carrying a cytoplasmic type of sterility and graft transmission did not occur. The only other alternative is that our research technician may have read some plants too soon, before fertile anther development; and male sterile plants were an error in classification. This point will be clarified in 1974.

C. New Sources of Cytoplasmic Male Sterility

In 1970-71 an epidemic of southern leaf blight occurred in corn and disease susceptibility was associated with the T cytoplasm. This made the nation aware of the vulnerability of field crops. A committee, supported by the U.S.D.A. and the Research Corporation of New York conducted a study on the vulnerability of major crops. They pointed out, as most breeders know, that there was only one source of cytoplasm being used today in the production of commercial hybrid sugarbeets.

In 1971, we studied three new sources of male sterility in sugarbeets and found them to be of the genetic type, (1971 Research Report, p C52-C53). Pilot studies on eight other sources of male sterility were reported in 1972 (1972 Research Report, p C36-C37).

This year we made a more detailed study of fifteen new sources of male sterility. These are shown in Table 2. We attempted to cross each male sterile source with 3-4 type O pollinators and with the 201 Rf and L-19 pollen restorer lines. We were unsuccessful in getting good seed set on all crosses and lost some material in our St. George steckling plot. However, two to six crosses were realized with each source of male sterility.

Segregation of these male steriles in crosses with O type and pollen restorer inbreds is given in Table 3. It is apparent that S33, S & O, A2934, A2935, A2937, A2938, and SL3302 sources are the same as the CMS source commonly used at present in commercial hybrids. The A2936 source was probably the same source of CMS although there were a few partial-fertile and fertile segregates when crosses were made with O type pollinators. Source A403 might also be classified with the group above, however, it does show less fertility than expected when crossed with 201 Rf. The 6209 and 6210 male steriles were probably genetic since crosses with O types gave fertile progenies. Crosses with restorers need to be made and selfed progenies studied before this conclusion is certain.

The GW1351 male sterile segregated differently than would be expected for the SLC129 and SLC133 type O pollinators. The crosses with 201 Rf resulted in less fertility from what we would have expected for our present source of CMS. Thus, this could be a new source of sterility. The GW1352 crosses with SLC133, NB-1, CT7 and 201 Rf pollinators behaved as if the sterility was of the genetic type in that all progenies were completely fertile. Crosses with the other two pollinators didn't confirm this, however, and more testing will be required to determine the inheritance of this line.

The A3900-19 source definitely showed results expected for a new cytoplasmic male sterile. All progenies with the CT7 and 128 type O pollinators were fertile, and most of the progenies from MS X 201 Rf and MS X L-19 restorers were male sterile. The other Turkish introduction A3900-132, behaved differently than expected with our present CMS and could also be a different source of sterile plasm.

Further testing of this and other plant material will be done during the coming years in an effort to develop new sources of CMS.

D. Variation in the Genetic Behavior of SLC129 CMS X 201 Rf vs NB-1 CMS X 201 Rf

In 1966 and 1968 greenhouse and field tests, two things were noted

relative to the genetic behavior of 129 CMS X 201 Rf and NB-1 CMS X 201 Rf populations. (1) These two male sterile lines segregate differently when crossed with the 201 pollen restorer. (2) NB-1 crosses showed a lower average fertility indicating that this line was superior to SLC129 in its ability to emasculate.

In 1973, we conducted an extensive detailed investigation into the differences between these two CMS lines crossed with 201 Rf. At the time of this report we have not completely evaluated all of the data, and we have not obtained all of the answers we sought. However, several findings are of interest.

Fourteen fertile 129 CMS X 201 Rf and 10 fertile NB-1 CMS X 201 Rf F_1 plants were self pollinated and backcrossed respectively to SLC129 CMS and NB-1 CMS. The F_2 and BC_1 populations were carefully classified visually and also microscopically by aceto-carmin smears of anthers or pollen. F_2 plants of different fertility were also selfed and later the F_3 populations were read for fertility in the manner cited above.

Plants were placed in four categories: MS 1, male sterile plants that have poorly developed pollen with no exine and often just a mass of tissue; MS 2 non-staining translucent pollen grains with fully developed exine; partial fertile and completely fertile pollen. Genetic tests were made by placing MS 2, PF and F categories in one class and the MSI in the other. This classification is based on the fact the MSI plants always remain sterile and MS 2 plants under certain environmental conditions produce some viable pollen, and will sometimes set seed.

Segregation of the F_2 and BC_1 populations is given in Tables 4, 5, 6, and 7. In the F_2, six of the eight populations of NB-1 CMS X 201 Rf fit a 3F:1 MS ratio; the two other lines gave a better fit to a 2F:1 MS ratio. The total segregation fit a 3F:1 MS ratio suggesting that one gene controlled fertility in the cross. In the BC_1, most of the crosses fit a 1:1 ratio substantiating the one gene model.

The F_2 and BC_1 segregation for 129 CMS X 201 Rf crosses showed a more complex inheritance pattern with individual crosses showing good fit to 9:7, 2:1, 3:1, and 1:1 ratios (Tables 6 and 7).

Figure 1 shows the percent of total plants for each population that were classified MS 1, MS 2, PF or F. The 129 F_2 population shows about equal percentages for MSI and F classes and less for the intermediate classes. NB-1 CMS shows far more sterility when crossed with 201 Rf than does the 129 CMS line. The average percent stainable pollen for the fertile classes (MS 2, PF and F) was 62%, and 31% in the F_2 and 59% and 8% in the BC_1 populations for 129 and NB-1 respectively.

The data on the F_3 crosses indicates that plants that have yellow

anthers, good pollen dehiscence and 90% stainable pollen are not genotypically the same (Table 8). Plants classed as partial-fertile show similar variation.

An interesting observation was made in sib crosses of male sterile F_2 segregates when they were crossed with 90% fertile sibs (Tables 9 and 10). Generally, the segregation of crosses was similar to that of the pollinator. Further research is planned on these populations.

E. Studies of Variation in Partial Male-Fertile Populations

Extensive research has been made to access the wide variation and genetic behavior of partial fertile populations derived from a single partial fertile SLC133 plant. Results have been reported in several previous reports.

1965 Research Report, p 125-130
1966 Research Report, p 167-171
1970 Research Report, p C44-C46
1971 Research Report, p C51
1972 Research Report, p C37-C38

In order to investigate different partial fertile source material, studies were initiated this year with five annual populations that Dr. F. V. Owens had classified as 90-100% partial fertile. Ten plants of each population were bagged and individual flowers were classified for fertility. Anthers were removed from each flower of one or two plants of each population after breaking them open over the stigma of the flower in which they were produced. Each seed was harvested individually and identified with tape so as to indicate its exact location on the seed parent.

Seeds of five plants from each population were planted in Japanese paper pots and later transplanted to 6-inch pots in the greenhouse. Each plant was bagged in the early flowering stage of growth and flowers on each plant were carefully examined for fertility. A 3X headband magnifier was used to access the fertility visually and a sample of pollen or anthers was squashed in aceto-carmin and examined microscopically.

Segregation for fertility in these populations is shown in Table 11. In the 01036 population, some lines had all fertile and all partial fertile plants. All lines of population 01044 gave partial fertile or male sterile, but no fertile offspring. The three other populations segregated mainly partial fertile with some male sterile and fertile plants in each line.

There was no association observed between the fertility of a plant and the place the seed developed on the seed parent as was suggested by some data obtained for the previously studied SLC133 partial fertiles. Likewise, we did not observe any specific effects of pollinating a flower

with its own pollen when compared with plants that may have had some degree of inter-flower pollination.

Crosses were made with several male sterile segregates and type O or pollen restorer lines. Data indicates that with the exception of a cross with type O pollinator 147 in population 7H323, these male steriles gave progeny fertility as expected with the particular pollinator (Table 12).

We intend to continue our studies with these and other populations to better understand the breeding and genetic behavior of partial male-fertile sugarbeets.

Table 1. Germination of Braune variety sugarbeet seed held 45 years in cold storage (0 to -10F).

Date of Germination	Length of Storage Years	Type of Storage	Germination Percent
1928	0	Metal Can	83.5
1942	14	Metal Can	86.5
1950	22	Cloth Bag	75.0
1964	36	Cloth Bag	68.0
		Glass Jar	60.3
1968	40	Cloth Bag	49.5
		Glass Jar	39.3
1973	45	Cloth Bag	37.5
		Glass Jar	42.6

Table 1a. Germination of five varieties of sugarbeet held in cold storage (0-to-10F) for 35 years.

Variety and Seed Year	Type of Storage	Germination Percentage					
		1938	1947	1960	1964	1968	1973
US # 1 1929	Cloth Bag	68.0	40.5	35.0	42.3	34.5	29.7
	Glass Jar				49.7	30.5	31.7
US # 33 1933	Cloth Bag	81.0	96.5	95.7	91.7	98.0	77.7
	Glass Jar				94.7	96.5	81.3
US # 22 1937	Cloth Bag	82.0	62.0	61.3	71.7	71.0	66.3
	Glass Jar				68.0	71.0	67.7
US # 15 1937	Cloth Bag	53.0	60.0	53.7	60.0	60.5	15.0
	Glass Jar				62.3	62.0	23.0
US # 12 1936	Cloth Bag	79.0	59.0	59.7	73.7	68.5	47.0
	Glass Jar				76.3	75.0	49.3

Table 2. New Sources of Male Sterility

Identification No.	Origin of Source
S33 MS	MS discovered by F. V. Owen in CT9 pollinator line in 1957 with a note in seedbook as inheritance not explained.
S&O MS 6209 6210	1950 seedlots marked "new source of MS"by F. V. Owen
A2934 A2935 A2936 A2937 A2938	Five male sterile lines received from Dr. V. Savitsky which he reported at the X International Congress of Genetics as sugarbeet lines with different plasms.
GW1351 GW1352	MS given to ARS by Dr. R. K. Oldemeyer of The Great Western Sugar Company.
A403	MS from Dr. Toshiro Kinoshita, Hokkaido University, Sapporo, Japan.
SL3302	MS Dr. Owen received from M. J. Zijp, Holland 1953.
A3900-19	MS isolated from an introduction of a sugarbeet from Turkey (Ames, Iowa collection).
A3900-132	MS isolated from an introduction of a mangel from Turkey (Ames, Iowa collection).

Table 3. Segregation of new sources of male sterility in crosses with O type and pollen restorer inbreds.

MS Source	Pollinator	Fertile	No. Plants Partial F.	MS
S33	SLC128	0	0	14
	SLC129	0	0	17
	SLC133	0	0	6
	E1 31	0	0	36
	L-19Rf	4	1	0
	201Rf	6	5	0
S&O	SLC128	0	0	8
	SLC133	2	3	21
	NB-1	0	0	6
	A1-12	2	6	29
	FC504	0	1	45
	L-19Rf	93	48	27
	201Rf	4	0	0
6209	SLC128	13	6	0
	NB-1	16	0	0
	L-19Rf	1	0	1
6210	128	12	0	0
	NB-1	3	0	0
GW1351	SLC129	50	0	0
	SLC133	8	12	3
	L-19Rf	50	30	19
	201Rf	5	5	4
GW1352	SLC133	4	0	0
	NB-1	65	0	0
	CT7	10	0	0
	CT5A	7	0	0
	A1-12	7	4	0
	L-19Rf	79	25	5
	201RF	14	0	0
A2934	SLC129	0	0	58
	FC504	0	0	7
	L-19Rf	10	1	2
A2935	SLC129	0	0	43
	FC504	0	5	17
	E1 31	0	0	37
	L-19Rf	27	8	0

Table 3 (continued)

MS Source	Pollinator	Fertile	No. Plants Partial F.	MS
A2936	SLC128	0	0	12
	SLC129	4	4	12
	SLC133	3	8	43
	E1 31	0	1	35
	F.C.504	6	6	91
	L-19Rf	21	4	1
	201Rf	15	8	0
A2937	SLC129	0	4	8
	SLC133	0	1	4
A2938	SLC129	0	0	31
	SLC133	0	0	60
	E1 31	0	1	70
	L-19Rf	5	7	14
	201Rf	24	18	0
A403	SLC128	0	1	15
	SLC129	3	3	159
	SLC133	1	0	118
	E1 31	0	1	71
	F.C. 504	0	3	210
	CT7	0	0	15
	L-19Rf	113	28	19
	201Rf	29	13	2
SL3302	SLC128	0	0	6
	SLC129	0	0	47
	CT7	0	0	44
	NB-1	0	1	20
	L-19Rf	76	56	34
	201Rf	3	0	0
A3900-19	CT7	24	0	0
	SLC128	3	0	1
	L-19Rf	1	0	2
	201Rf	1	10	43
A3900-132	SLC129	1	1	1
	SLC133	12	3	4
	NB-1	0	3	1
	A1-12	1	3	41
	L-19Rf	68	22	14
	201Rf	1	0	6

Table 4. Pollen fertility of F_2 plants of NB-1 CMS X 201 Rf

			3:1 Ratio		2:1 Ratio	
	F	MS	X^2	P	X^2	P
7113-19	94	25	1.16	.20-.30		
-20	37	19	13.43	<.001	.02	.80-.90
-22	100	35	.38	.50-.70		
-25	65	24	.21	.50-.70		
-26	59	22	3.49	.05-.10		
-28	72	22	.80	.30-.50		
-29	28	13	5.15	.02-.05	.10	.70-.80
-30	35	11	1.78	.10-.20		
	490	171	.60	.30-.50		

Table 5. Pollen fertility of BC_1 plants of NB-1 CMS X 201 Rf

			1:1 Ratio		7:9 Ratio		3:1 Ratio	
	F	MS	X^2	P	X^2	P	X^2	P
7113-19	22	33	4.40	.02-.05	.314	.50-.70		
-20	2	2	0.0	1.00				
-21	52	15	20.4	<.001			.244	.50-.70
-22	65	74	1.17	.20-.30				
-24	27	30	.316	.50-.70				
-25	48	59	1.13	.20-.30				
-28	27	45	4.50	.02-.05	1.14	.20-.30	6.0	.01-.02
-29	1	1	0.0	1.00				
-30	8	13	1.19	.20-.30				
	252	272	.76	.30-.50				

Table 6. Pollen fertility of F_2 plants of 129 CMS X 201 Rf

			9:7 Ratio		2:1 Ratio		1:1 Ratio		3:1 Ratio	
	F	MS	X^2	P	X^2	P	X^2	P	X^2	P
7113-1	48	21	4.97	.02-.05	.261	.50-.70				
-2	35	31	.28	.50-.70			.24	.50-.70		
-5	72	46	1.29	.20-.30	1.70	.10-.20				
-7	44	53					.84	.30-.50		
-8	75	68	.84	.30-.50			.34	.50-.70		
-9	69	39	2.56	.10-.20	.375	.50-.70				
-10	63	38	1.54	.20-.30	.837	.30-.50				
-11	77	33	8.45	<.001	.550	.30-.50	1.47	.20-.30		
-12	85	31	13.66	<.001	2.28	.10-.20	.18	.50-.70		
-13	44	22	2.91	.05-.10	0.0	1.00	2.44	.10-.20		
-14	58	49	.18	.50-.70	7.48	<.001				
-17	91	55	2.19	.10-.20	1.24	.20-.30	.17	.50-.70		
	761	486	11.56	<.001						

Table 7. Pollen Fertility of BC_1 plants of 129 CMS X 201 Rf

			1:1 Ratio		2:1 Ratio		9:7 Ratio		3:1 Ratio	
	F	MS	X^2	P	X^2	P	X^2	P	X^2	P
7113-1	43	35	.82	.30-.50			.04	.80-.90		
-7	19	14	.76	.30-.50			.02	.80-.90		
-11	48	69	3.77	.05-.10			.35	.50-.70		
-2	29	38	1.21	.20-.30	2.98	.05-.10				
-9	30	106					.63	.30-.50		
-10	59	109			.24	.50-.70				
-12	17	42			.54	.30-.50	.46	.50		
-13	5	31					2.37	.10-.20		
-15	55	54	.01	.90						
-17	12	24	4.00	.02-.05	0.0	1.00				
-18	32	77			.78	.30-.50	1.10	.20-.30		
	349	599			5.17	.02				

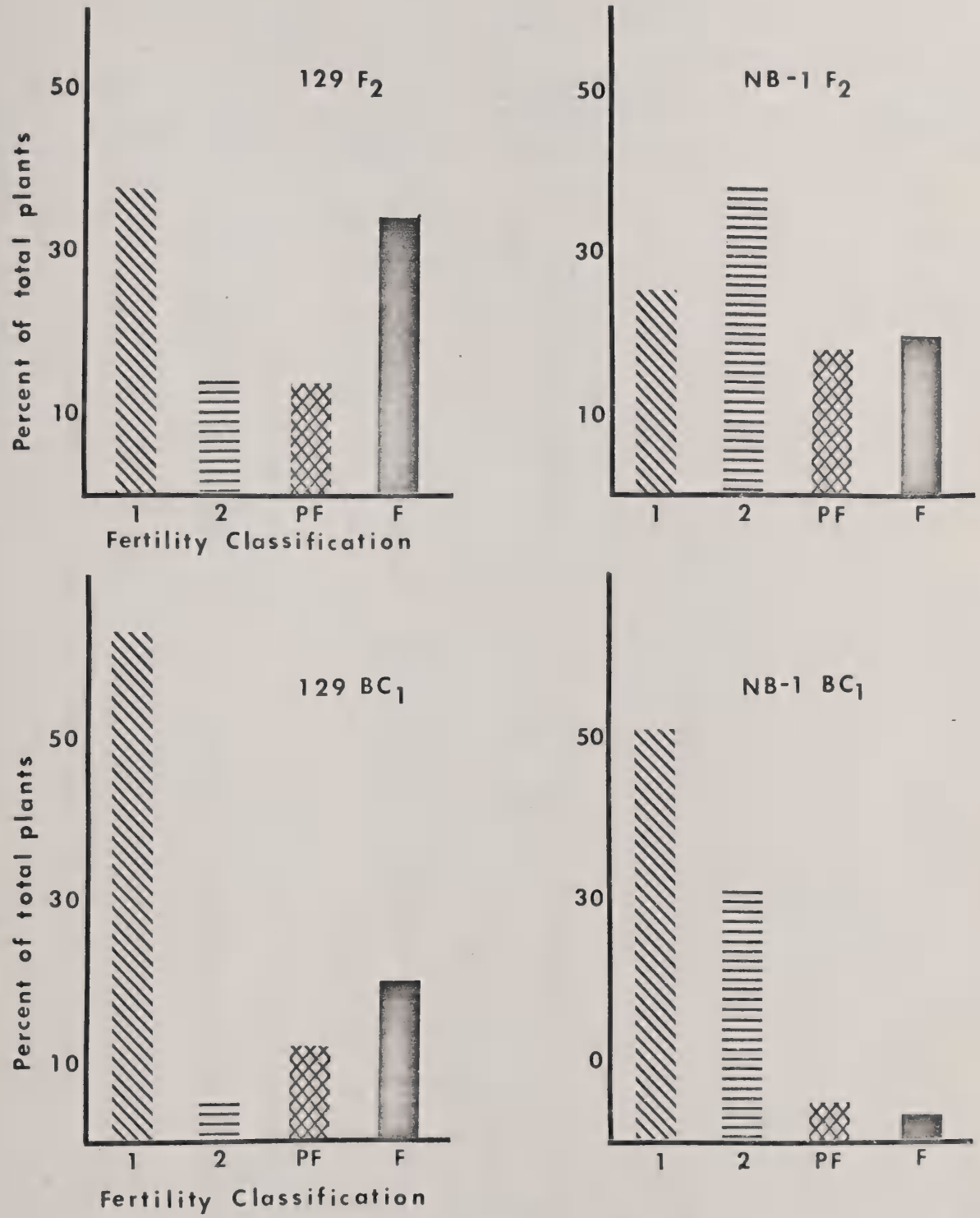

Figure 1. Fertility segregation in F_2 and BC_1 populations of 129 CMS X 201F_f and NB-1 CMS X 201Rf. (1 = Male sterile Type 1; 2 = Male sterile Type 2; PF = Partial fertile; F = Fertile)

Table 8 . Segregation for pollen fertility in F_3 progenies from F_2 plants of SLC 129 X 201 Rf and NB-1 CMS X 201 Rf.

		F_2 Parent Fertility		F_3 Pollen Fertility				
	No.	Visual Reading	Micro. Reading	MSI	MSII	PF	F	Total
7213-01 F_3	10	F	90	1	0	2	54	57
	41	F	90	0	2	2	16	20
	48	F	90	0	2	1	14	17
	12	F	90	14	0	3	26	43
	40	F	90	3	1	1	3	8
	55	F	90	3	2	3	9	17
	27	F	90	9	5	3	11	28
	53	F	90	0	1	2	1	4
	61	F	80	5	3	3	3	14
	25	PF-F	50	19	11	12	8	50
	2	PF	50	10	6	8	8	32
	9	PF	50	4	2	0	2	8
	29	PF	10	9	7	6	10	32
	20	PF	MS II	0	8	4	5	17
	38	PF	MS II	0	7	9	6	22
	13	MS-PF	MS II	6	6	1	4	17
7213-05 F_3	99	F	90	0	0	0	6	6
	69	F	90	0	0	2	4	6
	32	F	90	1	0	1	13	15
	33	F	90	1	1	4	7	13
	85	F	90	0	2	6	28	36
	53	F	90	0	1	2	4	7
	1	F	90	0	3	5	22	30
	6	F	90	0	11	6	18	35
	24	F	90	0	9	11	20	40
	61	F	90	2	3	5	15	25
	51	F	90	3	2	2	8	15
	20	F	90	2	1	2	4	9
	77	F	90	1	5	1	3	10
	70	F	90	1	2	1	1	5
	9	F	90	1	2	1	3	7
	10	F	90	7	3	6	12	28
	13	F	90	4	3	3	7	17
	18	F	90	5	4	2	6	17
	109	F	90	3	5	7	8	23
	16	F	80	6	2	1	5	14
	40	F	80	6	2	1	5	14
	62	PF-F	90	0	0	0	6	6
	63	PF-F	90	1	0	1	19	21
	17	PF-F	90	4	7	7	14	32
	12	PF-F	90	6	0	3	9	18
	27	PF-F	90	9	1	3	11	24
	58	PF-F	90	5	3	2	7	17

Table 8 . (Continued)

		F_2 Parent Fertility		F_3 Pollen Fertility				
	No.	Visual Reading	Micro. Reading	MSI	MSII	PF	F	Total
7213-05 F_3	48	PF-F	90	2	4	1	4	11
	35	PF-F	90	6	21	1	3	31
	96	PF-F	50	3	8	3	2	16
	72	PF	80	4	2	2	7	15
	80	PF	60	10	12	8	22	52
	43	PF	50	4	4	1	8	17
	66	PF	10	1	6	3	2	12
	41	PF	MS II	1	0	1	0	2
	45	PF-MS	50	4	0	1	9	14
	8	PF-MS	10	3	1	3	6	13
	56	PF-MS	MS II	5	2	2	1	10
	84	PF-MS	MS II	5	4	2	1	12
7213-07 F_3	72	F	90	0	1	0	8	9
	36	F	90	3	0	2	6	11
	17	F	90	3	2	0	9	14
	11	F	90	1	3	0	4	8
	16	F	90	7	5	3	12	27
	87	F	90	8	3	3	5	19
	5	F	90	11	1	1	5	18
	41	F	90	8	0	2	3	13
	8	F	90	10	2	1	3	16
	32	F	90	17	0	3	4	24
	70	F	90	3	1	0	3	7
	73	F	90	8	2	3	1	14
	4	F	80	21	4	2	5	32
	46	PF-F	90	11	2	2	7	22
	91	PF-F	80	8	4	5	3	20
	56	PF-F	20	6	1	0	0	7
	27	PF	50	2	0	0	3	5
	26	PF	10	5	0	0	3	8
	52	PF	MS II	5	3	0	5	13
	59	PF	MS II	3	2	0	4	9
7213-09 F_3	34	F	90	0	2	3	18	23
	37	F	90	1	0	0	3	4
	50	F	90	1	1	1	5	8
	97	F	90	4	2	1	10	17
	19	F	90	2	4	4	5	15
	68	F	90	5	5	2	5	17
	70	F	90	5	6	5	3	19
	105	F	90	4	4	0	5	13
	8	F	90	0	2	0	3	5
	29	F	90	0	4	0	8	12
	4	F	90	7	2	1	2	12

Table 8 . (Continued)

		F_2 Parent Fertility			F_3 Pollen Fertility				
		No.	Visual Reading	Micro. Reading	MSI	MSII	PF	F	Total
7213-09	F_3	13	F	90	7	1	0	3	11
		3	PF-F	90	5	6	5	10	26
		1	PF-F	50	0	6	3	3	12
		36	PF-F	50	2	1	0	2	5
		46	PF-F	50	3	1	1	1	6
		16	PF-F	50	23	3	1	1	28
		9	PF-F	10	3	5	0	2	10
		12	PF-F	10	12	7	0	0	19
		21	PF-F	MS II	10	2	4	0	16
		2	PF	50	0	1	0	3	4
		43	PF	50	3	4	0	3	10
		45	PF	50	5	2	1	3	11
		67	PF	40	9	8	4	9	30
		96	PF	10	0	2	1	5	8
		59	PF	MS II	3	1	1	3	8
		66	PF	MS II	4	1	0	3	8
		7	PF-MS	10	3	2	3	5	13
7213-10	F_3	23	F	90	0	0	1	2	3
		37	F	90	2	3	2	5	12
		19	F	80	6	12	2	6	26
		26	F	50	15	12	4	13	44
		7	PF-F	90	0	3	0	3	6
		8	PF-F	50	1	0	1	3	5
		45	PF-F	MS II	0	2	0	1	3
		28	PF	MS II	1	3	0	1	5
		24	MS-PF	MS II	0	0	0	6	6
7213-19	F_3	63	F	90	0	0	0	5	5
		90	F	90	0	0	1	3	4
		35	F	90	0	1	5	8	14
		42	F	90	1	5	5	8	19
		104	F	90	2	1	0	0	13
		45	F	80	0	5	4	4	13
		77	PF-F	90	5	8	8	6	27
		68	PF-F	70	0	6	2	4	12
		54	PF-F	50	2	1	0	0	3
		24	PF-F	10	3	2	5	1	11
		65	PF	10	15	15	4	7	41
		34	PF	10	5	2	0	4	12
		4	PF	MS II	2	8	6	3	19
		37	PF-MS	MS II	7	14	0	0	21

Table 8 . (Continued)

		F_2 Parent Fertility							
		No.	Visual Reading	Micro. Reading	MSI	MSII	PF	F	Total
7113-22	F_3	5	F	90	1	13	9	69	92
		18	F	90	0	1	0	10	11
		23	F	90	0	2	3	25	30
		54	F	90	0	1	1	3	5
		69	F	90	0	4	3	15	22
		104	F	90	0	11	2	18	31
		132	F	90	3	1	4	14	22
		28	F	90	18	10	8	14	50
		103	F	90	3	0	2	0	5
		25	F	90	1	21	10	0	32
		3	PF	70	7	8	2	18	35
		8	PF	70	3	2	8	17	30
		6	PF	30	12	9	6	28	55
		1	PF	Trace	3	8	2	0	13
		83	PF	Trace	3	9	5	7	24
		43	PF	Trace	7	8	1	2	18

Table 9. Sib crosses of male sterile Type I and 90% fertile plants from NB-1 CMS X 201 Rf populations (7213 series).

F_2 Parent			F_3 Pollen Fertility				
MS I Female		90% F Male	MSI	MS II	PF	F	Total
7213-19B-15	X	7213-19B-90	0	2	2	5	9
-17	X	-90	1	33	16	12	62
-18	X	-90	3	20	6	4	33
	⊗	-90	0	0	1	3	4
7213-19F-51	X	7213-19F-42	2	20	8	6	36
-60	X	-42	0	6	9	22	37
-71	X	-42	3	4	0	1	8
	⊗	-42	1	5	5	8	19
-43	X	-63	0	9	12	9	30
-44	X	-63	0	16	4	4	24
-74	X	-63	0	9	1	0	10
	⊗	-63	0	0	0	5	5
-48	X	-45	2	50	8	5	65
-49	X	-45	0	10	15	12	37
-66	X	-45	0	0	1	4	5
	⊗	-45	0	5	4	4	13
7213-22B-5	X	7213-22F-54	0	30	0	6	36
-6	X	-54	5	21	11	9	46
-10	X	-54	6	28	26	27	87
	⊗	-54	0	1	1	3	5
-16	X	-103	22	15	5	3	45
-21	X	-103	30	16	7	4	57
-33	X	-103	10	12	5	0	27
	⊗	-103	0	4	3	15	22
7213-22F-16	X	7213-22F-23A	13	26	6	0	45
-14	X	-23A	1	15	10	4	30
-46	X	-23A	5	16	8	2	31
	⊗	-23A	0	2	3	25	30
-19	X	-25	8	17	1	1	27
-26	X	-25	1	6	15	4	26
-32	X	-25	0	8	3	2	13
-37	X	-25	0	26	6	5	37
	⊗	-25	1	21	10	0	32
-76	X	-72	15	0	1	4	20
-79	X	-72	14	2	9	6	31
-81	X	-72	2	2	2	2	8
	⊗	-72	7	0	12	9	28

Table 10. Sib crosses of male sterile Type I and 90% fertile plants from 129 CMS X 201 Rf populations (7213 series).

F_2 Parent			F_3 Pollen Fertility				
MS I Female		90% F Male	MS I	MS II	PF	F	Total
7213-01B-5	X	7213-01B-15	23	7	1	7	38
-13	X	-15	26	5	2	8	41
-14	X	-15	23	13	2	2	40
	⊗	-15	13	3	8	1	25
-24	X	-44	34	3	1	9	47
-25	X	-44	28	6	0	11	45
-26	X	-44	24	3	4	6	37
-40	X	-44	31	6	0	9	46
	⊗	-44	18	5	2	23	48
-30	X	-45	8	5	1	2	16
-33	X	-45	11	1	1	2	15
-34	X	-45	25	6	6	17	54
-42	X	-45	38	6	7	12	63
	⊗	-45	4	0	0	6	10
7213-01F-3	X	7213-01F-12	13	1	4	14	32
-21	X	-12	17	6	6	8	37
	⊗	-12	14	0	3	26	43
-39	X	-48	0	0	1	13	14
-42	X	-48	0	1	0	30	31
-50	X	-48	0	0	0	28	28
	⊗	-48	0	2	1	14	17
7213-05F-5	X	7213-05F-6	2	11	2	4	19
-7	X	-6	1	2	3	3	9
	⊗	-6	0	11	6	18	35
-15	X	-13	6	4	4	3	17
-38	X	-13	11	3	2	5	20
-39	X	-13	15	9	0	8	32
	⊗	-13	4	3	3	7	17
-44	X	-61	0	2	1	13	16
-59	X	-61	5	3	2	3	13
-64	X	-61	7	7	4	2	20
	⊗	-61	2	3	5	15	25
-76	X	-69	0	2	2	10	14
-86	X	-69	0	6	4	6	16
-87	X	-69	0	1	5	18	24
	⊗	-69	0	0	2	4	6

Table 10. (Continued)

F_2 Parent			F_3 Pollen Fertility				
MS I Female		90% Male	MS I	MS II	PF	F	Total
7213-05F-95	X	7213-05F-109	21	4	1	2	28
-108	X	-109	21	0	0	2	23
-112	X	-109	4	1	0	2	7
	⊗	-109	3	7	5	8	23
7213-07F-2	X	7213-07F-11	9	0	3	7	19
-3	X	-11	3	0	0	1	4
-9	X	-11	18	6	0	0	24
	⊗	-11	1	3	0	4	8
7213-07F-47	X	7213-07F-26	4	1	1	4	10
-55	X	-26	5	0	0	1	6
	⊗	-26	5	0	0	3	8
-28	X	-46	12	1	0	0	15
-37	X	-46	6	3	0	2	12
	⊗	-46	11	2	2	7	22
-93	X	-91	16	2	0	1	19
-96	X	-91	4	2	1	2	9
	⊗	-91	8	4	5	3	20
7213-09B-33	X	7213-09B-8	0	7	0	2	9
-36	X	-8	0	0	1	2	3
-55	X	-8	3	1	3	12	19
	⊗	-8	0	2	0	3	5
7213-09F-5	X	7213-09F-4	2	5	0	2	9
-15	X	-4	12	1	1	9	23
	⊗	-4	7	2	1	2	12
-23	X	-29	3	5	5	8	21
-25	X	-29	3	3	2	4	12
	⊗	-29	0	4	0	8	12
7231-10F-29	X	7213-10F-26	6	2	0	2	10
-31	X	-26	12	5	0	0	17
-48	X	-26	1	1	0	1	3
	⊗	-26	15	12	4	13	44

Table 11. Fertility of selfed progenies of plants from five partial-fertile sugarbeet selections.

Parent Line	Population No.	No. Plants F	PF	MS
11106	7H111*	0	16	4
	114	1	1	1
	121	6	15	8
	122	2	17	11
	123*	3	2	2
01036	7H21*	6	16	8
	23	12	0	0
	26	0	17	0
	210*	0	1	4
	223*	2	0	0
01044	7H31	0	1	0
	37	0	20	7
	315	0	0	5
	324	0	3	2
	327	0	12	4
01046	7H41	7	4	2
	43	3	9	7
	46	2	21	7
	413	5	19	6
	414*	9	10	5
01047	7H52	6	12	8
	54	4	19	5
	516*	0	1	1
	524*	4	16	10
	525	0	4	1

* Each flower of parent plant was pollinated and anthers removed from the flower at anthesis for these populations.

Table 12. Fertility of crosses between male sterile segregates from two annual partial-fertile populations and type O and pollen restorer inbreds

Population No.	Cross	No. Plants F	PF	MS
7H318	MS X L-53	0	0	13
	MS X 147	0	0	12
	MS X 201 Rf	8	1	0
	MS X L-19 Rf	8	0	0
7H320	MS X 03	0	0	5
	MS X 147	0	4	8
	MS X 201 Rf	5	1	0
	MS X L-19 Rf	7	0	0
7H323	MS X L-53	0	0	13
	MS X 147	0	0	8
	MS X 201 Rf	17	1	0
	MS X L-19 Rf	15	1	0
7H53	MS X 03	0	0	14
	MS X 201 Rf	8	0	0
	MS X L-19 Rf	4	0	0
7H520	MS X L-53	0	0	3
	MS X 201 Rf	10	2	0
	MS X L-19 Rf	15	1	0

PHYSIOLOGICAL GENETICS

A. Mitochondrial Studies

(1) Complementation

Much of our work the past two years has been evaluating the complementation phenomenon in sugarbeet. Our initial studies (1), gave small complementation effects that appeared to be correlated with heterosis. Later, more extensive studies (1, 2) indicated that this phenomenon was of even less importance. On only one sampling date was complementation correlated with heterosis and on this sampling date the complementation was not significant. Our concern over the apparent differences in complementation effects in these two tests led us to an investigation of these differences. The only difference in the techniques was in the isolation procedure. In attempting to improve our isolations we found that we could centrifuge our isolates through a .5M sucrose gradient and not affect the rate and efficiency of the mitochondria, but could eliminate some proteinaceous material. We reasoned that this procedure gave us purer isolations and eliminated some of the broken and damaged mitochondria. Therefore, we used this isolation procedure in the latter tests.

To determine if this change in isolation procedure affected complementation, we tested four inbred combinations for complementation. Mitochondria were isolated for each inbred combination through a .5M sucrose gradient and without a sucrose gradient. ADP:O ratios were generally a little higher when isolations were made through a sucrose gradient (Table 1). When using the sucrose gradient, three of the four comparisons had negative complementation, but all comparisons gave positive complementation without the sucrose gradient (Table 1). One comparison for isolations without the sucrose gradient was not made because of insufficient root samples.

These results indicate that isolation through the sucrose gradient did effect the complementation. This tends to suggest that the complementation in our earlier experiments was perhaps complementation between broken or damaged mitochondria.

1. Sugarbeet Research. 1971 report. p c56-c70
2. Sugarbeet Research. 1972 report. p c47-c56

(2) Effect of Helminthosporium maydis (corn leaf blight) on sugarbeet mitochondria

In 1970 an epidemic of corn leaf blight (H. maydis) occurred in the United States. It was discovered that all hybrids carrying Texas CMS cytoplasm were susceptible to blight, but that hybrids carrying other types of cytoplasm were resistant. Further studies revealed that toxin from H. maydis would completely uncouple mitochondria of Texas cytoplasm

but have little effect on the respiration of mitochondria from other cytoplasms.

We were interested to see if this effect carried over to other crops and particularly sugarbeet, because of the similarity of the cytoplasmic male sterility. Toxin of H. maydis was supplied by Dr. V. E. Gracen of Cornell University. This toxin was tested on two lines having normal cytoplasm, two lines having cytoplasmic male sterility and a diploid and its tetraploid counterpart. Toxin (0.02 ml per 2 mg mitochondrial protein) was added after the second ADP addition (cycle).

State 3 oxidation rates were not affected by the toxin, but State 4 rates were significantly increased in each line (Table 2). This is indicative of a partial uncoupling and resulted in a significantly poorer R:C ratio in all lines (Table 2). The ADP:O ratio was significantly reduced in all lines except the two male sterile lines (153 CMS and 129 CMS). These two lines had a reduced ADP:O ratio due to the toxin, but of insufficient magnitude to be detected by the number of replications (6) used (Table 2).

All cytoplasms appeared to be affected by the toxin by about the same degree. Mitochondria from various sugarbeet cytoplasms were not affected by H. maydis toxin as severely as Texas CMS cytoplasm in corn.

B. Biochemistry of CMS

(1) Brassins hormone on male sterility

Brassins (a new hormone isolated from the pollen of rape plants) supplied by Dr. John Mitchell of the plant hormone and regulator lab at Beltsville, Maryland was studied in connection with male sterility of sugarbeet. Concentrations of 5, 1 and .5 percent Brassins were applied to branch tips and very young flowers of CMS plants. Applications were with a very fine glass rod. Flowers were observed at regular intervals for three weeks. No apparent effect of the Brassins hormone on pollen fertility was observed on any of the flowers.

(2) PH

A preliminary study of pH was conducted on developing anthers by squashing anthers on dual-tint narrow range pH paper. A big change in the pH was observed. In normal anthers the pH is around 7.0 from early meiosis until the breakdown of the tetrads. At this stage the pH starts dropping until it reaches 5.2 shortly before pollen shedding when the pH increases to about 5.6. CMS anthers have a similar pH trend except no increase in pH is observed toward the end of pollen maturity.

(3) Isozymes

A survey was made of the isozyme pattern of esterase and peroxidase in the leaves, petioles and roots of CMS and normal plants throughout the growing season. Several CMS lines and their normal counterparts were tested at weekly intervals throughout the growing season. There were some suggestions of maternal inheritance of some structural esterases; however, there was considerable variation in this material.

The structural patterns of these two enzymes was different in the different tissue tested and changed during the growing season. Additional bands (structural enzymes) appeared toward the end of the growing season.

We have also studied the esterase enzyme in developing anthers. The isozyme pattern of this enzyme was investigated in a cross carrying CMS and segregating for the restorer (RF) gene. Most of the male sterile plants were absent of the E3 esterase enzyme. In these tests many anthers were needed for each determination. This complicated our studies because of the difficulty of determining the meiosis stage visually. It became evident that a more detailed investigation of each flower was essential. With this goal in mind, we developed a technique such that esterase structural patterns of individual anthers could be investigated. With this technique, individual flowers can be studied, by using one anther to determine the stage of meiosis, 2 anthers to determine the pH and one anther to study the structural esterases. Such studies are presently in progress.

C. Genotype X Nitrogen Interaction (Cooperative Research with Dr. D. W. James, Utah State University

The negative relationship between nitrogen fertilizer and percent sugar is well established. Most studies on this relationship have involved standard commercial cultivars and relate only to those cultivars tested. Many breeders believe that there is a genotypic interaction of percent sugar with nitrogen fertilization and have been selecting for percent sugar under high nitrogen levels. This interaction has not been studied extensively. The present study is a preliminary test of a more extensive investigation of this interaction.

A test field of known fertilizer application for several years was selected. Several levels and types of nitrogen formulation were applied to replicated plots (40' x 10') in this field. Some nitrogen treatments were replicated over increasing levels of previous treatments to get a measure of the residual nitrogen. Four cultivars were randomized within each fertilizer treatment making the design a split-plot design. Sub-plots were single rows, 40 feet long. The four cultivars were UI#B (high yield and medium-low sugar), 4169 (high yield-low sugar), 4144 (medium yield-high sugar) and 11142 (medium yield-medium sugar).

Petiole samples were taken on September 11-14 from each plot and analyzed for nitrate nitrogen. Plots were harvested on October 30-31 and weighed. Samples were taken from each plot and analyzed for percentage sugar, nitrogen, sodium and potassium.

The fertilizer treatments are given in Table 3. There was no measurable effect of residual nitrogen on any of the measured characters. Therefore, treatments identical except for residual nitrogen were combined. This resulted in more replications per treatment and more precision measurements. The new treatment codes are found in Table 4.

All four cultivars responded to increasing levels of nitrogen with increasing yields (Table 5). However, there was a significant cultivar X nitrogen interaction. This interaction is shown in Figure 1. The yield types (UI#B and 4169) continued to increase in yield with increasing levels of nitrogen, whereas, the sugar types (4144) and 11142) tended to level off at the two higher levels of nitrogen.

Sugar percentage was reduced at the high nitrogen levels (Table 6). There was no effect of nitrogen at the 0, 50 and 100-S-NH_4 NO_3 levels. Cultivar 4144 was about 2 percentage points higher in sugar than the yield types (UI#B and 4169) at each nitrogen level (Table 6). There was no cultivar X nitrogen interaction for sugar percentage, i.e. all cultivars were affected by nitrogen similarly even though the sugar types were consistently higher in sugar percentage than the yield types.

Gross sugar effects were similar to the yield effects (Table 7).

However, the high sugar type (4144) ended up with more gross sugar than the high yield types.

Nitrogen in the roots at harvest time (Table 8), was closely associated with nitrogen treatment. It appeared that nitrogen in the roots of greater than 300 ppm reduced the sugar percentage while lower concentrations had little detrimental effects on sugar percentage. The high sugar types accumulated as much nitrogen in the roots as the low sugar types (Table 8). This suggests that genes affecting nitrogen accumulation are independent of genes affecting sugar percentage.

Sodium followed much the same trend as nitrogen except the high sugar types had lower sodium than the low sugar types (Table 9). Sodium correlated better with sugar percentage than did nitrogen. The effects of fertility level on potassium were not as great as with sodium and nitrogen (Table 10). It followed the same trend as sodium and nitrogen, but of less significance. The index was similar in effect to the quality factors (Table 11). This reflects the factors that go into the calculation of it. The fertility levels were reflected in the petiole nitrate nitrogen (Table 12). There was greater variation in this measurement than the other measurements and thus less significance. There were no differences between cultivars in petiole nitrogen. (Table 12).

D. Genotypic Competition in Selection

This is the second year in a continuing study on genotypic competition. Last year's research was reported in "Sugarbeet Research" in the 1972 report. This year's research involved two tests, one similar in nature to last year's test and the other involved intergenotypic competition between several commercial hybrids.

In the latter test nine entries (6 commercial hybrids, plus an experimental hybrid and its parents), were planted in pure and mixed stands with two common competitors (hybrids 8125 and $E0_4$). All plots were planted from transplants by the paper pot method. In mixed stand plots, each entry was planted alternately with the common competitors. Spacing between plants was 12 inches. A 97% stand was achieved. Records were kept of missing plants and just prior to harvest all plants missing a competing neighbor were removed. At harvest time, tops were removed and scalped by a rotobeater, and the crown of the common competitors sprayed with red paint. This allowed for sorting, weighing and sampling of the individual components of each mixed plot.

Nearly all entries yielded more in mixed stands with common competitor 8125 than in pure stands (Table 13). The mean of all entries in mixed stands with common competitor 8125 was significantly greater than their mean in pure stand (Table 13). 8125 was also significantly greater in the mixed stands than in pure stand (Table 13). This resulted

in mixed stands with 8125 being significantly superior to pure stands. Mixed stands with common competitor EO_4 were about the same as the mean of the pure stands. There was an interaction of entries times common competitors. This interaction is the result of some mixed stands yielding more than their pure stand means (Tasco A3 with 8125), whereas other mixed stands yielded less than their pure stand means (OVXL-19 with EO_4). This indicates that intergenotypic competition is not always additive as some researches have proposed.

One purpose of this study was to estimate the competitive ability (a genotype's performance when competing with another genotype) and competitive influence (a genotype's effect on its nearest neighbor) in relation to each genotype's performance when competing with itself. It has been suggested that a genotype having high competitive ability and positive competitive influence (causes an increase in yield in its competing neighbor), should be superior when competing with itself. The competitive ability and influence of each entry was calculated and correlated with its yield in pure stand. Correlations of competitive influence and a combination of competitive ability and influence were non-significant. Correlations between competitive ability and pure stand yield gave the most significant relationships (.84 with 8125 as the common competitor, and .90 with EO_4 as the common competitor.) Tasco A3 with 8125 had very good competitive ability and influence, but was among the lower yielders in pure stand (Table 13). Therefore, it appears as if competitive ability is the best measurement for estimating a varieties pure stand yield.

In the other competition experiment, three heterozygous populations (Het 1, 2 and 3) were planted in pure and mixed stand plots with two common competitors (EO_4 and AI-1-4) at 3 plant spacings (6", 12", 24"). They were interplanted so that competitive effects could be measured on individual plants. This test was planted and harvested by hand.

The competitive ability and influence of each population at each plant spacing was computed (Tables 14 and 15). At the 6" spacing, all populations had significant competitive ability with the inbred (Table 15), but only population Het 1 showed positive competitive ability with the hybrid (Table 13). Het 3 had the smallest competitive ability and Het 1 had the largest. Population Het 1 exhibited a negative competitive influence (Table 15), while Het 3 showed a positive competitive influence on the hybrid (Table 14). There appears to be a negative relationship between competitive ability and influence in these large heterozygous populations.

The experiment was designed so that genotypic competitive ability and competitive influence variances could be estimated. These variances were estimated by first subtracting the environmental variances. The environmental variances were calculated by the regression of means times variances on the uniform lines (EO_4 and AI-1-4). Variances reported in Tables 16, 17 and 18 are in percent of the calculated environmental variance. At the 6" spacing, the environmental competition

variance was so great that it masked the genetic and competition variances except population Het 2 which did exhibit significant genetic and competitive ability variances (Table 17). The 24" spacing should have had genetic variances, but absent of competitional variances, however, small competition variances were observed for populations Het 1 and Het 2 (Tables 16 and 17). Significant genetic and competition variances were observed for all three populations at the 12" spacing.

Table 1. ADP:O ratios of mitochondria isolated through a .5M sucrose gradient and without a sucrose gradient for 4 inbred parental sets.

Inbreds	Isolation Through .5M Sucrose Gradient		Isolation Without Sucrose Gradient	
	Midparent	1:1 Mix	Midparent	1:1 Mix
L53CMS and 0198s	2.66	2.50	2.00	2.09
L53CMS and CT9	2.30	1.80	2.39	2.62
L53CMS and (133 xm')	2.41	1.88	-	-
L33CMS and 0461	3.02	3.18	2.33	2.50
Mean	2.60	2.34	2.33	2.40

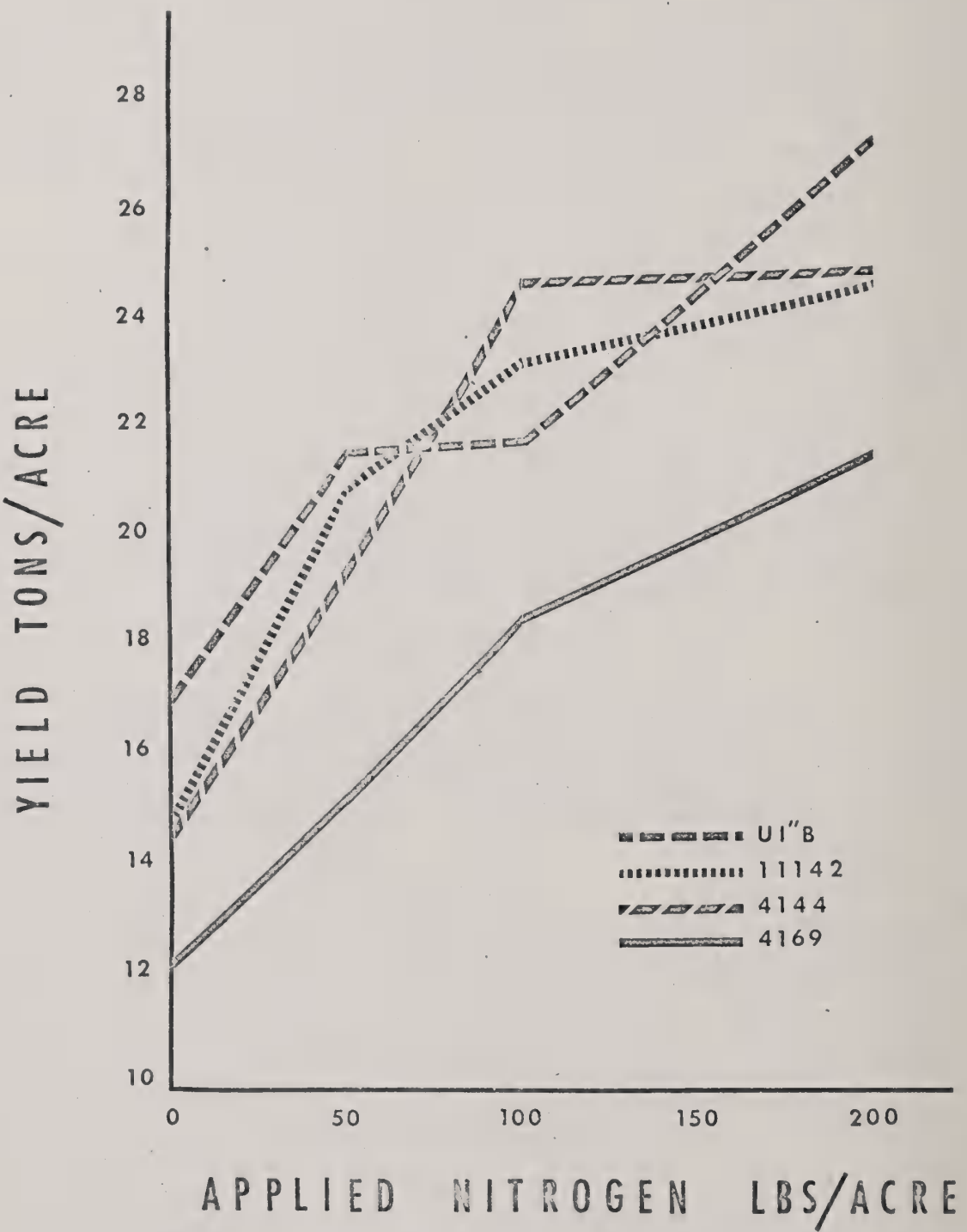

Figure 1. Interaction of the cultivars time yield at different nitrogen levels.

Table 2. Effect of *H. maydis*, race T Toxin on mitochondria of sugarbeet

Line	Measurement	Before Toxin	After Toxin	Toxin Effect as % of Check
	R:C			
L-19		1.82	1.43**	78
222		1.95	1.39**	71
153 CMS		1.59	1.21**	76
129 CMS		1.32	1.15**	87
Tetraploid		1.87	1.43**	76
Diploid		1.95	1.49**	76
	ADP:O			
L-19		2.17	1.67**	77
222		1.91	1.54**	81
153 CMS		1.69	1.52	90
129 CMS		0.81	0.78	96
Tetraploid		2.28	1.52**	67
Diploid		2.68	2.02**	75
	State 3 (mμ moles/O_2/min/mg mit. protein)			
L-19		43	41	95
222		41	41	100
153 CMS		61	66	108
129 CMS		39	46	117
Tetraploid		44	46	104
Diploid		94	98	104
	State 4 (mμ moles/O_2/min/mg mit. protein)			
L-19		25	29*	116
222		20	28*	140
153 CMS		38	53*	140
129 CMS		28	41*	146
Tetraploid		22	35*	159
Diploid		46	64*	139

* Significant effect of toxin at p = .05
** Significant effect of toxin at p = .01

Table 3 . Treatments and Treatment Codes for Nitrogen Application.

Treatment No.	1972 Fert. Code	1973 N Rates lb/acre	Time of Application	Type of Formulation
1	11	0	Spring '73	$NH_4 NO_3$
2	12	50	"	"
3	13	100	"	"
4	14	200	"	"
5	21	0	"	"
6	22	50	"	"
7	23	100	"	"
8	24	200	"	"
9	31	0	"	"
10	32	50	"	"
11	33	100	"	"
12	34	200	"	"
13	41	0	"	"
14	42	50	"	"
15	43	100	"	"
16	44	200	"	"
17	51	0	"	"
18	52	50	"	"
19	53	100	"	"
20	54	200	"	"
21	61	150	Fall '72	$(NH_4)_2 SO_4$
22	62	150	"	"
23	63	150	"	"
24	64	150	"	"
25	71	300	"	"
26	72	300	"	"
27	73	300	"	"
28	74	300	"	"
29	0	100	"	Sulfur coated urea
30	0	200	"	"
31	Alf	-	-	-
32	Alf	-	-	-
33	Alf	-	-	-

Table 4 . 1973 Treatment Codes

1.	No's 1, 5, 9, 13, 17	0-S-NH_4 NO_3
2.	No's 2, 6, 10, 14, 18	50-S-NH_4 NO_3
3.	No's 3, 7, 11, 15, 19	100-S-NH_4 NO_3
4.	No's 4, 8, 12, 16, 20	200-S-NH_4 NO_3
5.	No's 21, 22, 23, 24	150-f-$(NH_4)_2$ SO_4
6.	No's 25, 26, 27, 28	300-f-$(NH_4)_2$ SO_4
7.	No. 29	100-f-urea
8.	No. 30	200-f-urea
9.	No.'s 31, 32, 33	Alfalfa

Table 5. Yields (tons/acre) of the four hybrids at each nitrogen treatment

Treatment Code	UI#B	Hybrids 4169	41444	11142	Treatment Mean
0-S-NH_4 NO_3	17.17	12.29	14.88	14.93	14.82
50-S-NH_4 NO_3	21.46	15.17	19.58	20.99	19.27
100-S-NH_4 NO_3	21.78	18.67	24.75	23.38	22.14
200-S-NH_4 NO_3	27.39	21.57	24.96	24.72	24.66
LSD.05	3.00	3.00	3.00	3.00	1.20
Mean	21.94	16.92	21.02	21.01	
LSD.05	1.20				
150-f-$(NH_4)_2$ SO_4	17.17	12.99	17.28	14.64	15.52
300-f-$(NH_4)_2$ SO_4	24.29	20.75	20.21	20.50	25.70
LSD.05	3.40	3.40	3.40	3.40	1.70
Mean	20.73	16.87	18.75	19.07	
LSD.05	2.41				
100-f-Urea	27.84	23.47	22.19	26.77	25.07
200-f-Urea	28.57	27.73	29.23	27.31	28.21
LSD.05	6.80	6.80	6.80	6.80	3.40
Mean	28.21	25.60	25.71	27.04	
LSD.05	4.81				
Alfalfa	22.93	21.90	24.46	21.69	22.75
LSD.05	3.90				
Total Mean	22.82	17.89	21.08	20.60	
LSD.05	1.18				

Table 6. Sugar percentage of each hybrid at each nitrogen fertilizer treatment

Treatment Code	UI#B	4169	41444	11142	Treatment Mean
0-S-NH_4 NO_3	17.85	17.33	19.20	17.97	18.09
50-S-NH_4 NO_3	17.60	17.46	19.62	18.31	18.25
100-S-NH_4 NO_3	17.88	17.22	19.28	18.57	18.24
200-S-NH_4 NO_3	16.84	16.70	18.65	17.93	17.50
LSD.05	.48	.48	.48	.48	.23
Mean	17.51	17.18	19.19	18.19	
LSD.05	.24				
150-f-$(NH_4)_2$ SO_4	17.23	17.15	18.62	18.24	17.81
300-f-$(NH_4)_2$ SO_4	16.88	16.11	18.52	18.09	17.40
LSD.05	.59	.59	.59	.59	.25
Mean	17.06	16.63	18.57	18.16	
LSD.05	.42				
100-f-Urea	17.80	16.70	19.13	18.87	18.13
200-f-Urea	16.60	16.67	18.00	18.03	17.33
LSD.05	1.19	1.19	1.19	1.19	.55
Mean	17.20	16.68	18.57	18.45	
LSD.05	.84				
Alfalfa	16.69	16.28	18.04	17.67	17.17
LSD.05	.68				
Total Mean	17.39	17.00	18.98	18.20	17.89
LSD.05	.21				

Table 7. Gross sugar (lbs/acre) for each hybrid at each nitrogen fertilizer treatment

Treatment Code		Hybrids			Treatment Mean
	UI#B	4169	41444	11142	
0-S-NH_4 NO_3	6133	4263	5698	5372	5379
50-S-NH_4 NO_3	7558	5297	7668	7698	7055
100-S-NH_4 NO_3	7775	6413	9532	8669	8097
200-S-NH_4 NO_3	9147	7168	9312	8858	8621
LSD.05	1067	1067	1067	1067	466
Mean	7653	5785	8053	7649	
LSD.05	533				
150-f-$(NH_4)_2$ SO_4	5883	4442	6445	5334	5526
300-f-$(NH_4)_2$ SO_4	8198	6659	7466	7421	7436
LSD.05	1193	1193	1193	1193	596
Mean	7041	5550	6956	6377	
LSD.05	843				
100-f-Urea	9958	7830	8517	10058	9091
200-f-Urea	9467	9219	10512	9815	9753
LSD.05	2386	2386	2386	2386	1193
Mean	9712	8524	9515	9936	
LSD.05	1687				
Alfalfa	7636	7101	8794	7634	7801
LSD.05	1377				
Total Mean	7628	6014	7942	7482	
LSD.05	415				

Table 8. Nitrogen (ppm) in the roots of the four hybrids at each nitrogen treatment

Treatment Code	UI#B	4169	41444	11142	Treatment Mean
0-S-NH_4 NO_3	168	164	178	165	169
50-S-NH_4 NO_3	186	199	220	181	197
100-S-NH_4 NO_3	204	264	285	211	234
200-S-NH_4 NO_3	356	379	341	400	369
LSD.05	53				26
Mean	228	245	256	239	
LSD.05	26				
150-f-$(NH_4)2$ SO_4	219	181	220	150	193
300-f-$(NH_4)2$ SO_4	310	262	285	188	261
LSD.05	61	61	61	61	39
Mean	264	221	252	169	
LSD.05	46				
100-f-Urea	265	305	302	279	288
200-f-Urea	495	424	461	330	428
LSD.05	125	125	125	125	78
Mean	380	364	381	304	
LSD.05	92				
Alfalfa	347	274	296	291	302
LSD.05	70				
Total Mean	257	249	266	231	253
LSD.05	21				

Table 9. Sodium (ppm) in the roots of the four hybrids at each nitrogen treatment

Treatment Code	UI#B	4169	41444	1142	Treatment Mean
0-S-NH_4 NO_3	181	149	108	115	138
50-S-NH_4 NO_3	218	155	108	127	152
100-S-NH_4 NO_3	218	189	148	176	183
200-S-NH_4 NO_3	304	307	199	238	262
LSD.05	48	48	48	48	25
Mean	230	200	140	164	
LSD.05	25				
150-f-$(NH_4)_2$ SO_4	296	176	187	114	193
300-f-$(NH_4)_2$ SO_4	368	321	249	148	272
LSD.05	69	69	69	69	39
Mean	332	248	218	131	
LSD.05	50				
100-f-Urea	299	223	211	132	216
200-f-Urea	420	433	230	189	318
LSD.05	140	140	140	140	78
Mean	356	328	220	161	
LSD.05	101				
Alfalfa	365	423	416	383	397
LSD.05	90				
Total Mean	275	240	189	176	220
LSD.05	27				

Table 10. Potassium in the roots of the four hybrids at each nitrogen treatment

Treatment Code	UI#B	4169	41444	1142	Treatment Mean
0-S-NH_4 NO_3	1536	1730	1658	1780	1676
50-S-NH_4 NO_3	1488	1695	1611	1682	1619
100-S-NH_4 NO_3	1447	1757	1593	1808	1651
200-S-NH_4 NO_3	1559	1831	1697	1856	1736
LSD.05	145	145	145	145	73
Mean	1508	1753	1640	1774	
LSD.05	73				
150-f-$(NH_4)_2$ SO_4	1508	1684	1662	1629	1621
300-f-$(NH_4)_2$ SO_4	1609	1795	1725	1828	1739
LSD.05	162	162	162	162	81
Mean	1558	1740	1694	1729	
LSD.05	115				
100-f-Urea	1674	1898	1768	1767	1777
200-f-Urea	2006	2080	1785	1638	1877
LSD.05	325	325	325	325	162
Mean	1840	1989	1776	1702	
LSD.05	230				
Alfalfa	1748	2000	1635	1918	1825
LSD.05	187				
Total Mean	1562	1787	1661	1776	1696
LSD.05	57				

Table 11. The index for the four hybrids at each nitrogen treatment

Treatment Code	UI#B	Hybrids 4169	41444	1142	Treatment Mean
0-S-NH_4 NO_3	346	375	330	362	353
50-S-NH_4 NO_3	361	388	336	354	360
100-S-NH_4 NO_3	359	432	382	391	391
200-S-NH_4 NO_3	509	569	448	529	514
LSD.05	41	41	41	41	28
Mean	394	441	374	409	
LSD.05	28				
150-f-$(NH_4)_2$ SO_4	409	388	378	328	376
300-f-$(NH_4)_2$ SO_4	500	513	435	386	459
LSD.05	45	45	45	45	50
Mean	454	451	406	357	
LSD.05	32				
100-f-Urea	443	498	428	406	444
200-f-Urea	686	656	554	449	586
LSD.05	91	91	91	91	100
Mean	564	577	491	427	
LSD.05	90				
Alfalfa	556	568	478	513	529
LSD.05	52	52	52	52	
Total Mean	434	463	399	407	426
LSD.05	16				

Table 12 . Petiole nitrogen of each hybrid at each nitrogen fertilizer treatment.

Treatment Code	Hybrids UI#B	4169	41444	11142	Treatment Mean
0-S-NH_4 NO_3	156.36	260.67	127.00	183.80	182.39
50-S-NH_4 NO_3	195.13	217.21	123.20	187.53	180.15
100-S-NH_4 NO_3	180.00	290.14	235.13	289.00	247.15
200-S-NH_4 NO_3	1219.60	1062.33	1123.00	1566.07	1242.75
LSD.05	428	428	428	428	214
100-f-$(NH_4)_2$ SO_4	359.33	231.42	324.58	211.00	281.58
200-f-$(NH_4)_2$ SO_4	1110.42	1181.50	818.58	442.25	888.19
LSD.05	425	425	425	NS	213
100-f-urea	756.66	580.66	567.33	239.33	536.00
200-f-urea	1723.00	914.66	1192.33	2454.66	1571.00
LSD.05	NS	NS	NS	NS	NS
Total Mean	500	550	480	550	
LSD.05	NS				

Table 13 . Yield (Tons/Acre) of each variety in pure stand and in mixed stands with the two common competitors.

	Pure Stand	With 8125	8125 (In Mixed Stand)	Pure Stand	With EO_4	EO_4 (In Mixed Stand)
1. USH20	28.39	34.53	20.90	31.49	33.30	17.77*
2. USH9	28.37	30.34	27.37	33.22	28.94	23.72
3. TascoA3	23.98	32.04**	30.58	26.81	27.41	26.80
4. UI#D	24.59	24.61	30.08	28.64	28.85	26.54
5. Holly	33.81	39.42*	26.15	33.79	40.70*	22.38
6. GW	30.74	37.96*	22.81	32.84	38.80*	25.24
7. OVX L-19	22.48	28.27*	27.55	27.97	22.44*	25.65
8. OVI	24.58	23.84	38.11*	23.57	20.71	32.19
9. L-19	21.29	13.56*	30.36	21.11	15.62*	26.27
Common Competitor (pure stand)			26.24			26.24
$\bar{x}$	26.47	29.40	28.21	28.82	28.53	25.17
LSD.05	4.78	5.96	7.35	4.43	7.10	7.40

* = Significantly different from pure stand yield at p = .05
** = Significantly different from pure stand yield at p = .01

Table 14 . Competitive ability and influence at the 3 plant spacing with common competitor EO_4 (Hybrid).

	Het 1		Het 2		Het 3	
	Competitive Ability	Competitive influence	Competitive Ability	Competitive Influence	Competitive Ability	Competitive Influence
6"	140**	104	98	113	56**	109
12"	95	115	53**	115	91	120*
24"	85	104	98	100	92	116

* = Significant at p = .05
** = Significant at p = .01

Table 15 . Competitive ability and influence at the 3 plant spacing with common competitor AI-I-4 (Inbrid)

	Het 1		Het 2		Het 3	
	Competitive Ability	Competitive Influence	Competitive Ability	Competitive Influence	Competitive Ability	Competitive Influence
6"	369**	42**	199**	95	154**	105
12"	129*	83	110	72	106	117
24"	109	66*	99	72	117	75

* = Significant at p = .05
** = Significant at p = .01

Table 16 . Variances of Het 1 as % of calculated variances from regression analysis.

	Pure Stand	Mixed Stand			
		With EO_4	EO_4 With Het 1	With Al-1-4	Al-1-4 With Het 1
6"	96	112*	97	90	156*
12"	404*	83	92	78	155*
24"	121	127	150*	147*	141

* = Significant non-environmental variance at p = .05
** = Significant non-environmental variance at p = .01

Table 17 . Variances of Het 2 as % of calculated variances from regression analysis.

	Pure Stand	Mixed Stand			
		With EO_4	EO_4 With Het 2	With Al-1-4	Al-1-4 With Het 1
6"	119*	114*	86	169*	114*
12"	148*	120*	96	72*	122*
24"	155*	72	117	142	136

* = Significant non-environmental variance at p = .05
** = Significant non-environmental variance at p = .01

Table 18 . Variances of Het 3 as % of calculated variances from regression analysis.

	Pure Stand	Mixed Stand			
		With EO_4	EO_4 With Het 3	With Al-1-4	Al-1-4 With Het 3
6"	87	93	86	79*	95
12"	207*	387*	93	73*	121*
24"	95	142*	66*	119	105

* = Significant non-environmental variance at p = .05
** = Significant non-environmental variance at p = .01

Postharvest Respiration Studies

Roger Wyse

Respiration accounts for approximately 70% of the sucrose lost under good storage conditions. Currently in progress is a research program designed to determine the factors influencing the respiration of sugarbeet roots and to develop methods of reducing or eliminating these factors. Details of an automated respirometer built to facilitate this work are given elsewhere in this publication.

Work in previous years has indicated that varieties vary greatly in respiration rate. This past year the respiration rate of 60 inbreds and 42 hybrids from Michigan, Utah, and Washington was monitored during storage. A summary of the results are given in Table 1.

There was a 3.5 fold range in the respiration rate of the sixty inbreds indicating ample genetic variability for efficient selection and breeding.

The extremes in respiration rates were absent in the hybrids, but the mean rate was slightly higher.

Figure 1 shows the results of one genetic study included in the data in Table 1. In this study the inbreds ranged from .215 to .375 lbs/ton/day.

The respiration rate of the hybrids showed a strong tendency to align with the lower respiring female parent. However, these results are preliminary and are presented merely to illustrate the potential for genetic selection of improved storage varieties.

The experiment presented in Figure 1 was run at two locations, Logan and Farmington, Utah. There was a .76 correlation between the respiration rate of the individual varieties at the two locations. This is very close to the correlation normally found between root yields at the two locations.

There was no significant correlation between sucrose content or root size and respiration rate. This confirms our previous work on sucrose content, root size and respiration rates at low temperature.

This indicates that selection for low respiration rates should have no detrimental effect on sucrose or yield.

Growth regulating compounds which would substantially increase sucrose when applied to sugarbeets prior to harvest would be of great benefit. Most of the compounds now being tested retard late season growth and thus should increase sucrose storage. However, any treatment imposed on the sugarbeet crop immediately prior to harvest may

affect storage characteristics. Fourteen compounds which have been previously tested for their effect on the sucrose content of sugarbeets were applied four weeks before harvest.

The effect of these compounds on root respiration is given in Table 2. For some unknown reason the variability was unusually high in this experiment and thus a 20% difference between the controls and treatments was required for significance at the 5% level. None of the chemicals significantly reduced respiration but nine of the treatments had an adverse effect. The experimental compound CP41845 caused a tremendous increase in respiration rate. After 100 days of storage, the roots from the CP41845 treatment began to show signs of physical deterioration. No recommended rate was given for this compound so the rates used may have been much too high. However, these results indicate that all compounds applied late in the growing season should be tested for their effect in storage.

Table 1. The range in respiration rates between inbreds and hybrids from Michigan, Utah and Washington measured at 5 C.

	Entries	Respiration Rate	
		Mean	Range
		lbs/ton/day	
Inbreds	60	.180	.110-.393
Hybrids	42	.193	.15 -.309

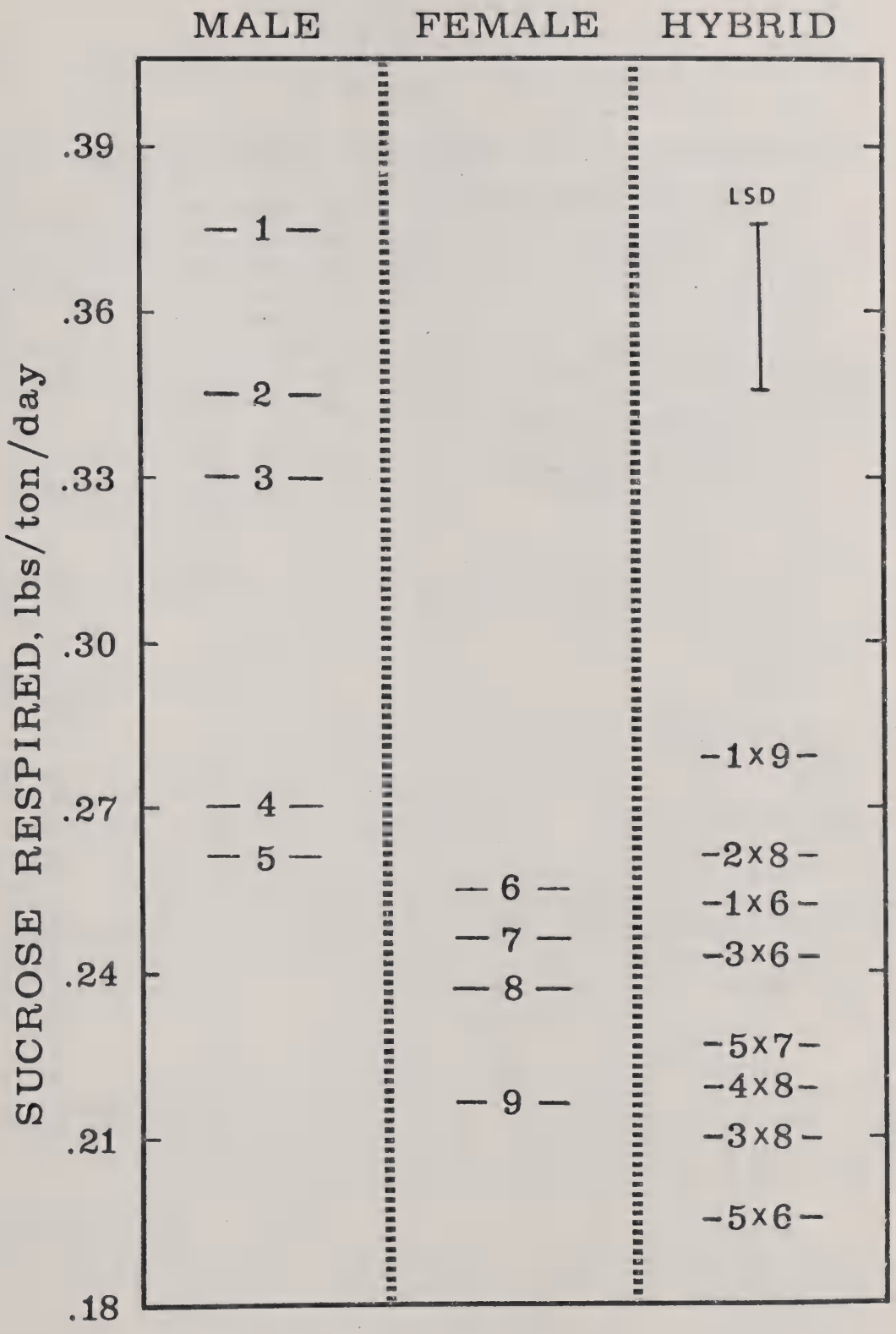

Figure 1. Respiration rates of hybrids and their component inbreds.

Table 2. Effect of chemicals applied preharvest on root respiration during storage.

Treatment	Application Rate 1/	Respiration Rate Percent of Control	Differ from Control
Pyrocatechol	4	92	
Gibberelic Acid	.65	96	
CHE8728	.12	111	
CHE8728	.06	113	
Indoleacetic Acid	2.6	108	
Indoleacetic Acid	1.3	101	
Indoleacetic Acid	.65	103	
Naphthalene Acetic Acid	2	118	
Naphthalene Acetic Acid	4	100	
Ethrel & Maleic Hydrazide	.5 + .5	129	*
Ethrel	1	126	*
Ethrel	.5	127	*
Maleic Hydrazide	1	123	*
Maleic Hydrazide	.5	129	*
Polaris	1	128	*
Polaris	.5	119	
CP41845	1.3	384	*
CP41845	2.6	305	*
Cycocel (CCC)	2	114	
Cycocel (CCC)	4	112	
Alar	1	112	
Alar	2	122	*
Vanadium Sulfate	4	115	
Kinetin	.65	99	

1/ lbs/ac

Imbibed Seed Respiration and Seedling Growth Potential

Roger Wyse, Devon Doney, J. Clair Theurer

The ability to predict the yield potential of a breeding line in the seedling stage would greatly reduce the time required to produce an improved variety. Schmehl has shown that early growth rate, primarily leaf area, was a major factor in determining final yield in sugarbeet. Therefore, seedling vigor may play an important role in determining the yield potential of a sugarbeet variety.

Woodstock (1965, 1967) and Edje (1970) have shown a good correlation between imbibed seed respiration and seedling vigor. In their experiments, seed respiration was an index of seedling vigor after seed quality had been altered by various handling and storage regimes. Others have shown that seed size, and environmental conditions during seed development influence seedling vigor and germination rates in sugarbeet. (Battle 1971a, 1971b) (Snyder, Personal Communication).

It was the purpose of this investigation to determine if imbibed seed respiration rates could be used to predict seedling vigor and subsequently the yield potential of sugarbeet breeding lines.

MATERIALS AND METHODS

The respiration rates of imbibed seeds were determined by incubating the seeds on blotter paper in a germination chamber at 30 C for 20 hours, and then transferring the 20 seeds to a 10 ml vial fitted with a serum stopper. A 2 1/2 ml syringe containing 1ml of air was inserted through the septum and the syringe and vial placed in a constant temperature incubator at 30 C. After one hour the syringe was pumped several times to thoroughly mix the contents before 1ml was removed for injection into a gas chromatograph for CO_2 analysis. Respiration rates were then calculated as $\mu l CO_2$ produced/hr/germinated seed. A germinated seed was considered to be any seed with a 5 mm radicle after 5 days on blotter paper.

Two experiments were run to establish a relationship between seedling vigor, as measured by speed of emergence, and growth potential. In the first experiment, polished seed of uniform size were planted at a depth of 2 cm in greenhouse soil and the date of emergence noted for each seedling. After three weeks the individual plants were harvested and the fresh weight determined.

This same seed was used in a field trial where plots were thinned either normally (random) or to those plants emerging first or to those

plants emerging last. A plot was a single 40 ft row with each treatment replicated 6 times.

To determine the effect of "aging" on seedling vigor and respiration rates, commercial seed was brought to 25% moisture and then held at 40 C in sealed containers for 38 and 110 hours. The seed was then air dried and stored for later use.

RESULTS AND DISCUSSION

The speed of emergence showed a very strong relationship to growth rate during the 21 days after planting. The first plants emerged 5 days after planting and approximately 90% had emerged by the 7th day. All plants emerging after the 7th day were treated as a group. The rate of dry matter accumulation per day is shown in Figure 1. Growth rate dropped in a linear fashion as emergence was delayed.

The field experiment where plots were thinned according to date of emergence confirmed the greenhouse data (Table 1). The early emerging treatment out yielded the late emerging treatment by 44%. The random hand thinned treatments were not significantly lower in yield then the early emerging treatment. One would expect the random thinning to produce a yield midway between the other two treatments; however, the hand thinners apparently tended to leave the larger plants, thus increasing the yield.

Seed from a diallel cross (6 females, 4 males) was planted in yield trials at two locatons; Farmington and Logan, Utah. Respiration rates were determined 20 hours after imbibition on the same seed lots. Correlations between seed respiration and final root yields were then determined.

Root yields at Farmington ranged from 19.8 to 31 tons per acre and from 18.5 - 29 tons at Logan. Seed respiration rates showed a significant correlation ($r = .52$) at Farmington, but only a 0.2 correlation at Logan. These results were rather disappointing because there was a 6 fold range between crosses in respiration rate and the respiration rates followed very closely apparent seed quality as evidenced by speed of germination.

In an attempt to explain the lack of correlation between respiration rate and root yield of the breeding lines, a study was made of the relationship of seed "aging", respiration rate, and seedling growth rate.

All treatments reached full emergence at about 150 hours after planting (Fig 2). Therefore, aging the seed had very little effect on the rate of seedling emergence, but did reduce the final percent emergence by 27%.

Seed respiration was reduced by 36%, but plant weight after 21 days

was reduced by only 14% compared to the control. The respiration rate followed very closely both the final percent emergence and average plant fresh weight. Therefore, it appears that the primary effect of aging was to reduce seed viability with a lesser effect on subsequent growth rates.

In an experiment involving seedling vigor, the exact history of the seed should be known. This was not done in this experiment. However, from a practical standpoint, the plant breeder cannot precisely control seed production practices from year to year. The objective of this study was merely to evaluate seed respiration as a tool for the plant breeder under his normal scheme of seed production and cross evaluation.

These results indicate that seedling vigor is a factor in determining final root yield. Seedling vigor is influenced by environmental conditions during seed development, maturity at harvest and length of storage, as well as the genetic make-up of the seed. Respiration measurements of imbibed seed are an index of seedling vigor, but environmental conditions during the growing season greatly influence the relationship between seedling vigor and final yields. Therefore, imbibed seed respiration rates are not a good indicator of final root yield in sugarbeets.

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Woodstock, L. W. 1966. A respiration test for corn seed vigor. Proc. Assoc. Offical Seed Analysts. 56:95-98.

Battle, J. P., and W. J. Whittington. 1969. The influence of genetic and environmental factors on the germination of sugar-beet seed. J. Agric. Sci. Camb. 73:329-335.

Battle, J. P., and W. J. Whittington. 1971. Genetic variability in time to germination of sugar-beet clusters. J. Agric. Sci. Camb. 76:27-32.

Table 1. The effect of emergence rate on final root yields.

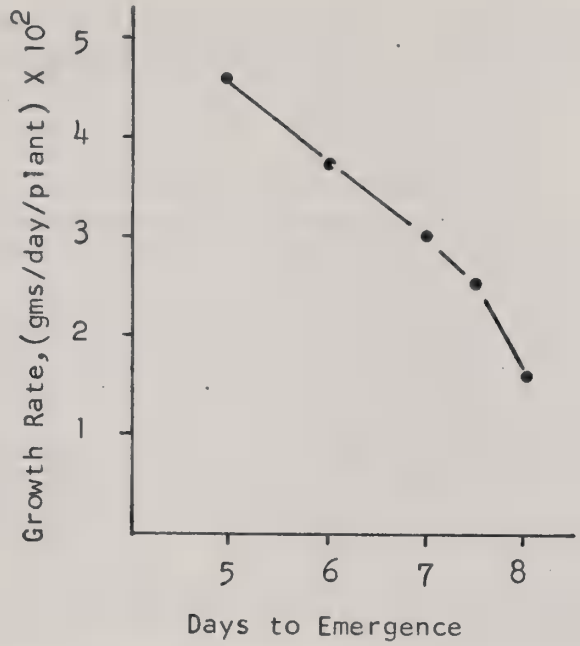
Thinning Treatment	Root Yields lbs/plot
Emerging First	48.9
Emerging Last	33.9
Random	47.8
LSD .05	7.7

Table 2. Effect of aging seeds at 40 C on imbibed seed respiration rates and plant fresh weight after 21 days.

Treatment	Respiration Rate	Average Fresh Weight
	μlCO_2/seed/hr	gms/plant
Control	5.6 a	8.4 a[1/]
Aged 38 hours	4.9 a	7.5 b
Aged 110 hours	3.6 b	7.2 b

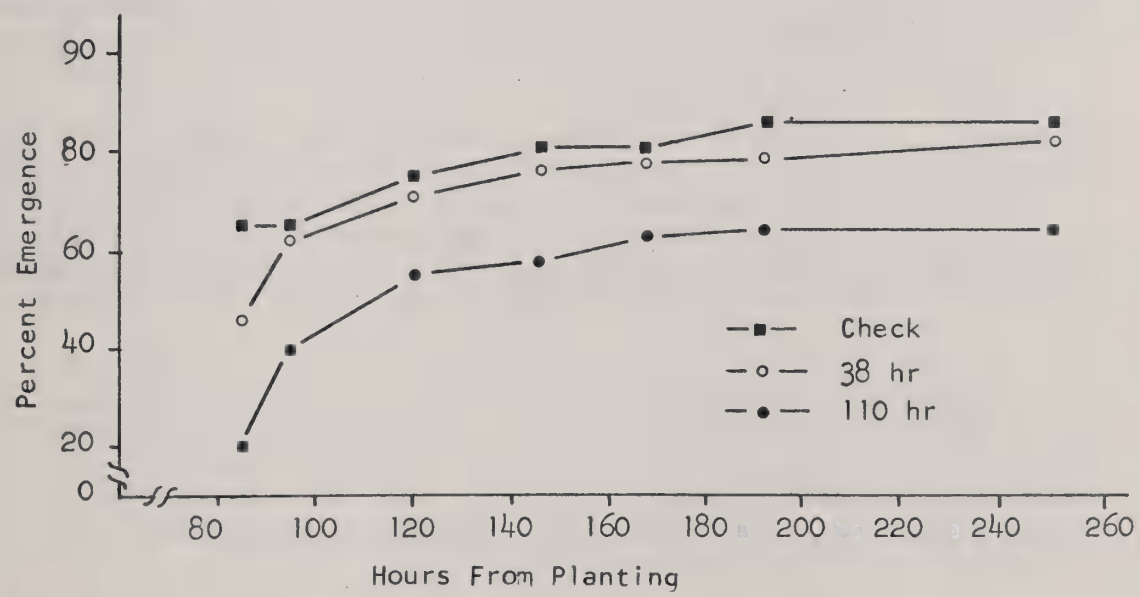
1/ Numbers followed by the same letter are not significantly different at the 5% level of probability.

Fig 1.



The relationship between days to emergence and growth rate during the first 21 days after planting.

Fig 2.



Effect of aging at 40 C on the rate and final percent emergence of sugarbeet seed.

Automated System for Determining Carbon Dioxide Gas Exchange in Plant Materials

Roger E. Wyse

Determinations of the respiration rate of plants or harvested plant organs are essential to a number of investigations. Knowledge of the respiratory behavior in sugarbeets will facilitate the development of improved techniques for harvesting, handling and storing this perishable crop. Since respiration is the major component of sucrose loss during storage the effect of agronomic practices, variety and growth regulators on storage respiration rate must be studied.

An automated system of CO_2 analysis is described which has proven to be an accurate and dependable research tool over one year of operation. This system is uniquely adapted for the measurement of respiratory gas exchange in sugarbeet roots but is readily converted for use in other studies such as seed or whole plant respiration. The system is also designed for efficient coupling to a Burroughs 6700 computer for data reduction.

EXPERIMENTAL:

A flow diagram of the sample handling system is shown in Figure 1. There are 100 respiration chambers (8) located in a constant temperature room. (Fig 2). The room is capable of maintaining set temperature to within $\pm$1C over the range -2 to 20 C. The room is equipped with a capillary flow meter assembly (Fig 2), which supplies individual chambers a measured flow rate of CO_2 free air. A fixed flow rate of air at 500 ml per minute is routinely employed. The assembly is calibrated to deliver rates of 500, 400, 300, 200, 100 ml per minute. Sample weights and flow rates can be modified depending on tissue type, temperature and other experimental variables in order to achieve measurable CO_2 levels in the flowing gas stream. The CO_2 content of the incoming air is monitored under the exact same conditions as for the sample containing chambers.

As the air flows over the samples at a precisely controlled rate the CO_2 content is enriched from its initial value. The effluent gas from each chamber flows to a sampling manifold of 3-way solenoid valves. (Fig 3). The flow of air is normally exhausted through the solenoid valve. On command from the sequencing control, the proper solenoid valve is closed and a representative sample of the effluent gas is diverted to the infrared analyzer.

Thus, a sample of the effluent gas from any of the 100 chambers is available on command to enter the sample intake manifold in sequence. The sample passes through a diaphragmpump which supplies the sample

under pressure to the analyzer. The flow rate through the pump is adjusted with a fine metering valve to supply 250 ml per minute to the analyzer. The excess is vented to the atmosphere. The sample gas is held at an absolute pressure of 760 mm Hg in the analyzer by absolute pressure regulators (16, 17). This assures a constant analyzer output with changes in barometric pressure.

Sample selection is by a solid state switching system controlled by two timers: the hour timer initiates a sampling sequence at the desired time interval, i.e., 6, 12, 24, etc. hours. (Fig 4). The minute timer controls the analyzer purge time between samples. The time required to purge the previous sample and obtain a stable reading is approximately 2 minutes. Normal operating procedure is to allow a purge time of 10 min. Output from the IRGA is recorded by a digital printer 30 seconds before switching to the next sample.

The IRGA has a range of 0-2000 ppm CO_2. Standard gases are automatically introduced into the IRGA at the beginning of each cycle. The output from the analyzer is slightly nonlinear with increasing CO_2 concentrations. A quadratic equation of CO_2 concentration as a function of analyzer output is used as part of a computer program to calculate respiration rate. The computer program also corrects all readings for analyzer drift as needed for each cycle. Drift from zero and span reference points is extremely slight over periods of days. Respiration rates are then calculated by the following equation:

$$\text{mg } CO_2/\text{kg/hr} = \frac{\text{flow in ml/hr}(273)(2)}{(\text{weight in kg})\ (T)}$$ (Change in CO_2 conc. in sample pail), where T is the absolute temperature of the plant material. The constant factors for a given experimental sample are grouped into a single constant to simplify calculation.

The 2000 ppm CO_2 range of the IRGA allows the use of beet root samples weighing up to 30 pounds at 5 C and 500 ml per min air flow. At warmer temperatures the size must be reduced accordingly to keep the CO_2 concentration within range. Under normal operating conditions 3 1/2 days is sufficient to produce data accurate to $\pm$.01 lbs/Ton/day of sucrose respired using 3 replications of 10 beets each.

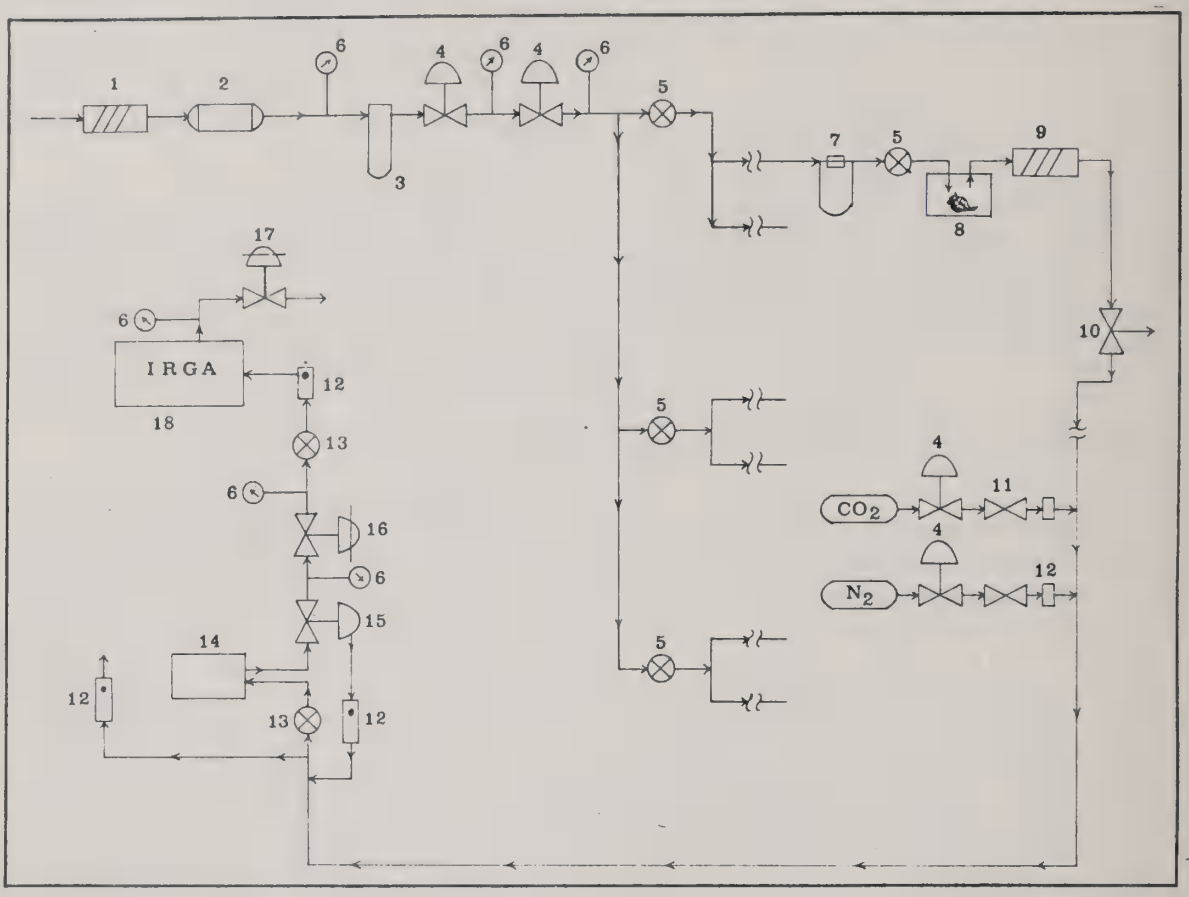


Figure 1. Air flow diagram of respirometer

1. Calcium Oxide-fiberglass filter
2. Air compressor
3. Filter
4. Pressure regulator
5. Needle valve
6. Pressure guage
7. Capillary flow meter
8. Respiratory chamber
9. Glass wool filter
10. 3-way solenoid valve
11. 2-way solenoid valve
12. Flow meter
13. Fine metering valve
14. Diaphragm pump
15. Pressure relief valve
16. Absolute pressure regulator
17. Absolute back pressure regulator
18. Infrared gas analyzer

Figure 2. Interior of cold room showing capillary flow boards and sample chambers.

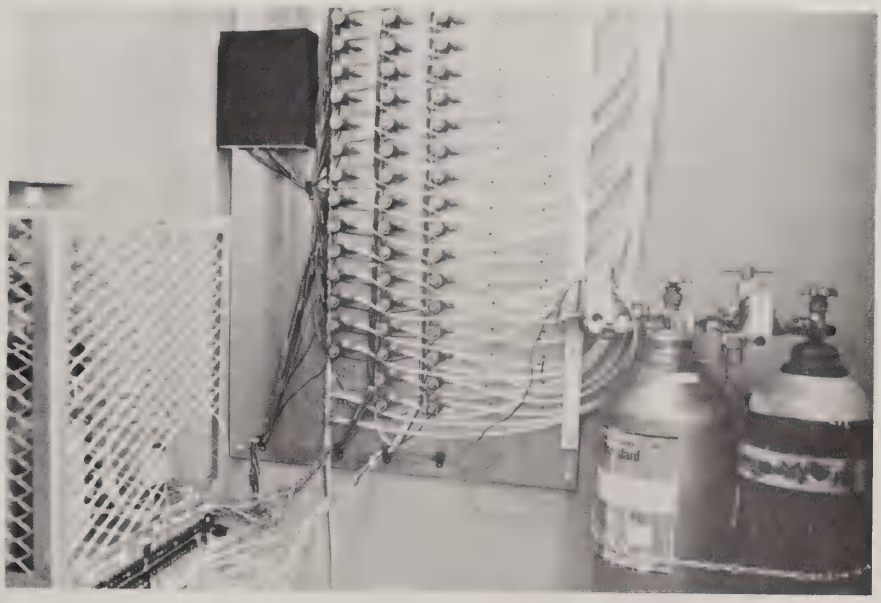


Figure 3. Solenoid valve manifold for controlling sample flow to analyzer.

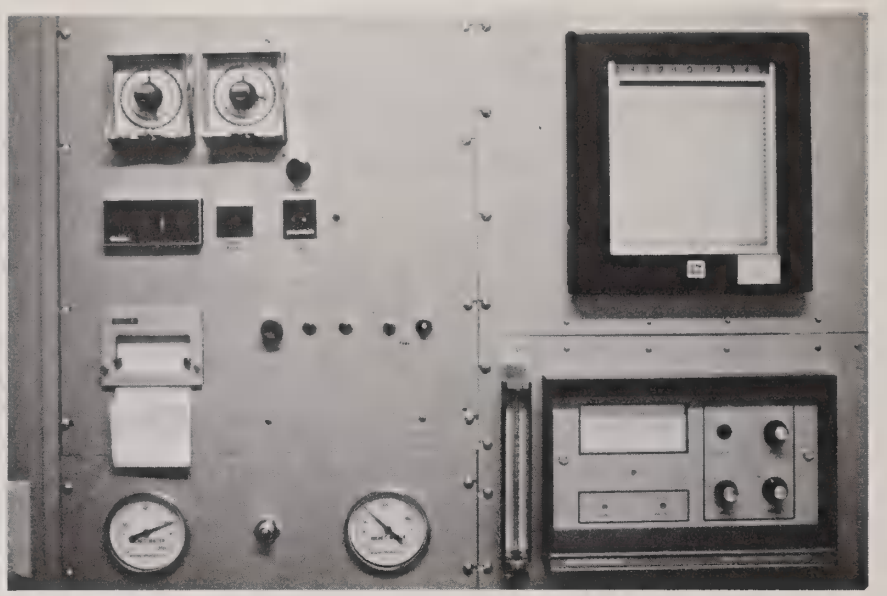


Figure 4. Control panel containing timers, infrared analyzer digital printer and analog recorder.

Purification of Curly Top Virus

David L. Mumford

Curly top virus was purified from infected tobacco plants. Preliminary testing indicated that tobacco would be a better host from which to extract the virus than sugarbeet. A plant-infectivity bioassay, accomplished by allowing the beet leafhopper vector to feed on infectious solutions, was used to follow the virus through a purification procedure that is believed to have yielded nearly pure virus particles.

Extracts from infected tobacco were clarified with chloroform and butanol. The clarified virus was concentrated by precipitation using polyethylene glycol and sodium chloride. Concentrated virus preparations were layered onto sucrose density gradients and centrifuged to separate the virus from most plant materials.

Further purification was accomplished by allowing the virus preparation to flow through an agarose-gel chromatographic column. The virus fractions from this column were examined with an electron microscope. Curly top virus particles were observed to be very small spherical bodies about 20 nanometers in diameter.

The small size of curly top virus indicates it is one of the smallest plant viruses known. The purification of this virus permits the application of several biological techniques to studying its relationship to its vector, its hosts, and to other viruses.

SUGARBEET RESEARCH

1973 Report

Section C

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American Crystal Sugar Company
Great Western Sugar Company
Holly Sugar Corporation
New Mexico Agricultural Experiment Station

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CONTENTS

SUMMARY OF ACCOMPLISHMENTS, 1973

Sugarbeet Quality Studies

A study was made of gas liquid chromatography (GLC) and polarimetric sucrose determinations and the glucose content of eight different juice extracts prepared from ten genetically different cultivars grown at two nitrogen fertility levels; there were 10 replications. The juices were either prepared by different methods or analyzed before and after storage at -30° C. In most cases, the GLC sucrose was lower than the sucrose determined polarimetrically. Phosphated thin juice was one exception. The phosphated thin juice also contained the lowest proportionate amount of glucose; while the lead defecated juice contained the highest proportionate amount. Overall, the experiment did not clearly indicate that any one type of juice is superior for comparison of the two sucrose determinations. There were significant differences between the juice extracts and between cultivars. Also there was a significant interaction between cultivars and the different juice extracts. There were no significant differences related to the two nitrogen fertility levels.

An experiment designed to compare the quality characteristics of eight juices and extracts from 10 cultivars at two nitrogen (N) fertility levels showed no difference in sucrose content of fresh and frozen brei; but there were differences among the different juices for sucrose, thin juice purity, amino N, total N, sodium, potassium, chlorides, and ash. From this experiment it appeared that a 1 brei:1 water extract, blended and vacuum filtered, was the most consistently appropriate juice, among the eight tested, for determination of purity and the nonsugars. Freezing of this juice for later analysis cannot be recommended. So, the best practical method appears to be freezing of brei samples followed at some later date by extraction and immediate analysis for purity or nonsucrose characters.

A study of freezing effect on sugarbeet juice GLC sucrose determinations was made on juice extracts prepared from two genetically different cultivars grown at two nitrogen fertility levels; there were 12 replications. Juice extract was prepared from fresh brei with water (1:1) and divided. One portion of each sample was prepared for GLC analysis immediately, the second portion was stored at -30° C for two weeks before analysis. A second portion of the fresh brei was stored at -30° C for about two weeks, then thawed, and juice extract was prepared as before and analyzed before refreezing. Overall, this experiment showed that freezing the extract or the brei, before juice extraction, at -30° C, had no significant effect on the sucrose content determined by GLC analysis.

Nine samplings of five sets of Great Western Sugar Company processing juices (diffusion, thin, and thick juices, standard liquor, and

molasses) were measured for percent sucrose polarimetrically and by gas liquid chromatography. Glucose, 20 individual amino acids, two amides, pyrrolidone carboxylic acid, and ammonia were also quantitatively determined. The pol sucrose was higher than the GLC sucrose in each factory juice, apparently because other dextrorotary compounds present in the juices, besides sucrose, caused a higher positive (dextro) optical rotation reading than the sucrose alone. The resultant effect of the amino acids and their related compounds in the juices on the specific rotation was levorotary (-), however, the glucose present, which is dextrorotary, overcame this effect, but apparently did not add appreciably, if any, to the total dextrorotation. Therefore, other compounds, possibly such as raffinose which is highly dextrorotary, must have been present to effect the sucrose polarimetric readings.

Genetic and Breeding Studies Including Disease Resistance

A small experiment comparing reciprocal crosses of Rhizoctonia root rot resistant and susceptible sugarbeet lines showed that there were no reciprocal differences for Rhizoctonia resistance. Hence, there would appear to be no cytoplasmic or maternal factors affecting resistance to root rotting strains of *Rhizoctonia solani*.

A limited test of ploidy level effects on Rhizoctonia resistance showed that tetraploid Rhizoctonia resistant sugarbeet lines were no more or less resistant than their diploid equivalents. However, there was evidence that triploid hybrids of resistant by susceptible lines, where the resistant parent was tetraploid, may be more resistant than the equivalent diploid hybrid.

Progress in breeding for resistance to Rhizoctonia root rot was measured by comparing the resistant breeding lines which have been developed over time. Rhizoctonia resistance has been progressively improved through seven cycles of mass and mother-line selection. The most resistant line has been improved from 27% healthy roots to 67% in inoculated field tests. Continued progress toward a goal of 100% healthy roots is likely but the rate of progress is expected to diminish.

A laboratory test for photosynthetic efficiency was developed to the point that greenhouse grown lines could be compared. Comparisons of inbreds and hybrids for changes in dry weight accumulation after artifical light treatment revealed differences ranging from 4 to 20%. The technique developed utilizes leaf discs taken in sets from greenhouse grown plants. Phase two of the experiment will include correlation of laboratory tests with performance results of the same lines grown in the field.

Formulation of models which best describe the relation of purity and nonsucrose constituents was achieved by use of a statistical procedure known as path coefficient analyses. Variables which are known

to affect crystallization such as Na, K, NO_3, N, amino N, Cl, total N, betaine, and ash were included in the formulated models. Models which most accurately describe purity were found to differ according to year, soil nitrogen level, and the type of juice used in the chemical determinations. Models were developed which account for over 80% of the variation in apparent purity. The use of path coefficient analyses enabled us to rank as to order of importance the variables which are known to affect purity.

A four year study to determine the heritability of resistance to *Cercospora* leaf spot in sugarbeet was completed. Narrow sense heritability estimates which are indicative of additive gene action were .243±.026. These values compared very favorably with realized or true heritability (determined by actual high, low selection) of .239.

Continued experiments testing ethephon as a potential chemical male sterilant on sugarbeet have shown that soil incorporated granular ethephon was of no practical value as a gametocide on sugarbeet. It was quite phytotoxic and induced less male sterility than ethephon applied as a foliar spray in previous experiments.

ABSTRACTS OF PAPERS APPROVED FOR PUBLICATION

RUPPEL E. G. Factors affecting conidial dimensions of a Drechslera species. Mycologia (In press).

Growth medium, culture age, and temperature, but not mounting medium, affected the size of conidia of the *Drechslera* state of *Cochliobolus spicifer*. Larger conidia were produced on oatmeal and potato dextrose agars than on corn meal, Czapek's, and malt extract agars. Conidia produced at 15 C were larger than those produced at 28 C, and those from 7-day-old cultures were larger than those from the same cultures 14 days old. Conidia produced on living or dead tissue of *Bouteloua gracilis* were larger than those from potato dextrose agar. Light had no effect on conidial size. Results demonstrate the importance of using standardized cultural conditions in comparative studies of fungal species.

RUPPEL, E. G. and P. R. SCOTT. Strains of Cercospora beticola resistant to benomyl in the USA. (Approved by ARS for publication in Plant Disease Reporter.)

Cercospora beticola isolates from six benomyl-sprayed sugarbeet fields in northern Texas showed in vitro resistance to benomyl. Texas, Colorado, and Maryland isolates from fields having no history of benomyl application were benomyl sensitive. Growth rates in culture did not reveal differences in vigor between benomyl-resistant or sensitive isolates. Attempts to induce benomyl resistance by growing sensitive isolates on increasing amounts of benomyl in vitro were unsuccessful.

SMITH, G. A. and E. G. RUPPEL. Heritability of resistance to Cercospora leaf spot in sugarbeet. Crop Sci. 14:Jan-Feb 1974.

Narrow sense heritability estimates adjusted to account for inbreeding of parental lines were compared with realized heritabilities obtained by actual selection for high and low resistance to *Cercospora beticola* in sugarbeet (*Beta vulgaris*). Parental, F_1, F_2, F_3, and polycross populations from high and low selections were field grown under an artificially induced leaf spot epidemic. Heritability estimates in %, were 24.3±2.9 and 24.3±2.4 for each of two resistant X susceptible crosses. These values were compared with realized heritabilities of 20.47% and 26.71% for the same two resistant X susceptible crosses. Environmental variation accounted for 44 to 62% of the total variation for leaf spot resistance.

SMITH, G. A. and E. G. RUPPEL. Association of Cercospora leaf spot, gross sucrose, percentage sucrose, and root weight in sugarbeet. Can. J. Plant Sci. 53:695-696 (July 1973)

Infection of sugarbeet, *Beta vulgaris*, by *Cercospora beticola*, significantly reduced sucrose %, root weight, and consequently gross sucrose. Reductions of more than 30% in gross sucrose occurred when field leaf spot readings were only 3 on a 0-10 scale. Increase in leaf spot severity was closely paralleled by reduction in gross sucrose.

SUGARBEET DISEASE INVESTIGATIONS, 1973

E. G. Ruppel

Rhizoctonia Root Rot

EXPERIMENT 1R, FIELD.--*Methods of inoculation.*--Three methods of inoculation compared in the field were: (1) rosette at 0.8 cc/plant; (2) side dress with a 'Planet Jr.' belt seeder at 24 cc/20-foot row; and (3) center-row banding at 48 cc/20-foot row. Side dress inoculation was performed about 7 weeks after planting, whereas the other inoculations were at 8 weeks after planting. Dried, ground barley-grain inoculum of *R. solani* (R-9) was used throughout. A noninoculated control was included in a randomized complete block design with six replications and two cultivars (highly susceptible FC 901, and resistant FC 701/5). Each root was dug and evaluated for rot on September 26, and a disease index was calculated for each plot. Mean disease indices of both lines on a scale of 0 to 7 were: rosette, 2.3; side dress, 0.0; banding, 3.3. Root rot was significantly more severe in plots inoculated by banding than in those inoculated by the rosette method. Significantly more rot occurred in FC 901 than in FC 701/5. The side dress method failed to induce root rot. The banding method shows promise as an easy, labor- and time-saving method of inoculating sugarbeets with *Rhizoctonia* in the field. Attempts are being made to mechanize the technique using a tractor-drawn applicator.

EXPERIMENT 8 - 12R.--*Evaluation of contributed lines.*--Seventy-six entries from Amalgamated, American Crystal, Holly, Great Western, and Spreckels sugar companies, and ARS-East Lansing, and ARS-Salinas were evaluated for Rhizoctonia resistance in five experiments. Five replications were used in each randomized complete block design. A Fort Collins resistant control, FC 702/5, was included in each test. Results of each company's test were analyzed and sent to company breeders. Generally, the resistant control had significantly less rot than other entries. Hybrids with resistant parentage were more resistant than entries having no history of selection or breeding for Rhizoctonia resistance.

Cercospora Leaf Spot

Phytoalexin induction.--Antifungal compounds (phytoalexins) are produced in sugarbeet in response to infection by *Cercospora beticola*. Various methods, reported in the literature for other host-pathogen systems, were tried in attempts to induce phytoalexin formation. Methods tested were: (1) UV-irradiation of intact plants and leaf disks; (2) virus inoculation; and (3) spore-suspension inoculation of leaf disks. In all tests, non-necrotic tissue samples were lyophilized, extracted with acetone, and separations made by thin-layer chromatography 96 hours after treatment. Three cultivars tested included US 201 (highly resistant), SP 6322-0 (moderately resistant), and [52-334 X 51-319] (highly susceptible hybrid). All assays for phytoalexins were negative. Apparently, necrosis is necessary for phytoalexin

formation. Or, necrosis is an indicator of phytoalexin production in sugarbeet. Although phytoalexins accumulate within 72-96 hours in other host systems, it is possible that a longer duration is needed in sugarbeet. (This study was conducted in cooperation with Gestur Johnson and Dale Maag, Colorado State University Chemistry Department.)

Comparison of Cercospora beticola and C. apii.--Johnson and Valleau (Phytopathology 39:763-770, 1949) presented evidence that *C. beticola* is synonymous to *C. apii*. A comparison of a Florida celery isolate of *C. apii* and a Colorado sugarbeet isolate of *C. beticola* indicated that both isolates induced typical leaf spot in sugarbeet. The isolates could not be distinguished on the basis of conidiophore or conidial morphology. Mean measurements of 100 spores of each isolate grown on sugarbeet leaf extract agar were 70.6 X 2.1 µ for *C. beticola*, and 71.4 X 2.3 µ for *C. apii*. Although the specific epithet *apii* has precedence over *beticola*, continued use of the latter will preclude unnecessary confusion in the literature.

Attempts to induce benzimidizole resistance in Cercospora beticola.--Isolates C-1 (from leaf spot susceptible sugarbeet) and C-5 (from resistant beet) were grown for two week intervals on increasing amounts of benomyl and thiabendazole in potato dextrose agar. Concentrations of fungicides were 0.01, 0.1, 1.0, and 10.0 µg/ml (ppm). Both isolates were slightly inhibited by 0.01 or 0.1 µg/ml of the fungicides. At 1.0 µg/ml, benomyl was completely inhibitory, whereas thiabendazole was only slightly inhibitory to both isolates. Neither isolate grew on 10 µg/ml of the fungicides.

Benomyl-resistant strains of Cercospora beticola.--150 single-spore isolates from six benomyl-sprayed sugarbeet fields in northern Texas were resistant to 5.0 µg/ml (ppm) benomyl in vitro. Texas, Colorado, and Maryland isolates from fields having no benomyl history were completely inhibited by 1.0 µg/ml benomyl. Benomyl-resistant strains have been reported from Greece, where other benzimidizole derivatives also were ineffective in controlling leaf spot. The buildup of resistant strains warrants that the exclusive use of benzimidizole compounds (including thiophanate) on large acreages be discontinued. Other fungicides, such as triphenyl tin hydroxide, should be alternated or combined with the benzimidizoles in areas where leaf spot is a problem. (This study was conducted in cooperation with Paul Scott, Holly Sugar Corporation.)

Growth rates of benomyl resistant and sensitive strains of Cercospora beticola.--Growth rates of three benomyl-resistant Texas isolates, three sensitive Texas isolates, two Colorado isolates (sensitive), and a Maryland isolate (sensitive) were determined by measuring colony diameters on potato-dextrose agar at 3 and 7 days after plating. Differences in growth rate among isolates were significant; however, no definite pattern of vigor was evident between resistant and sensitive groups.

QUALITY STUDIES

A Study of Gas Liquid Chromatographic and Polarimetric Sucrose Determinations and Glucose Content of Sugarbeet Juices Prepared by Several Methods

G. W. Maag and R. J. Hecker

This experiment was designed for continued study of the best practical method of preparation, storage, and analysis of sugarbeet juice samples for quality evaluation. Also, to compare quality evaluators across nitrogen (N) fertility levels and cultivars in order to determine the best quality evaluator factors. This experiment consisted of two major parts which will be discussed in separate sections in this report. The first section will compare gas liquid chromatography (GLC) sucrose and polarimetric sucrose determinations and the relative glucose content of several types of sugarbeet juice samples prepared from different cultivars grown at two N fertility levels. The second part of the report considers the nonsugar components total N, amino N, total ash, and the nitrate, chloride, sodium and potassium ions which were selected as possible quality evaluators and which were determined on the same sugarbeet juices.

GLC sucrose readings have been found to be more accurate than polarimetric sucrose determinations, since polarimetric readings are subject to inaccuracies caused by the presence, in varying amounts, of other rotatory compounds in sugarbeet juices. For example, glucose, an invert sugar found in sugarbeet juices, is dextrorotary, as is sucrose, therefore, its presence would tend to give higher dextrorotary readings than the sucrose alone which, in turn, would give higher and inaccurate pol sucrose determinations. Other rotatory compounds, besides glucose and sucrose, present in the juices may have an additional effect on the polarimetric readings. Fructose, for example, is levorotary, and some amino acids, also present in sugarbeet juices, are dextrorotary and some levorotary.

Material and Methods. Ten genetically different cultivars were field grown in a split plot design; main plots were two nitrogen fertility treatments: low N (80 lbs N/acre applied preplant), and high N (200 lbs N/acre, 80 lbs preplant and 120 lbs side dressed post thinning). Sub-plots were 10 cultivars with 10 replications. All 10 replications were used in the nonsugar component study (second section of this report); five replications only were used in the two sucrose and the glucose determinations (first section of this report). The cultivars were:

Entry no.	Cultivars and/or description
1	US H9B; commercial hybrid
2	US H20; commercial hybrid
3	HH 10; commercial hybrid, Holly Sugar Co.
4	GW 359-56R; former commercial variety, Great Western Sug. Co.
5	GW Mono Hi; commercial hybrid, Great Western Sug. Co.
6	52-305 CMS X Ovana, F_1
7	Fort Collins 3-way experimental hybrid
8	52-307 CMS X 54-346, F_1; high purity, homogeneous
9	52-305 CMS X 52-307, F_1; high purity, homogeneous
10	Ovana; fodder beet, low purity

At harvest time, 1200 g of well blended brei was prepared from the beets from each replicate, divided, and eight juices were prepared as follows:

Juice I Equal parts of brei and room temperature glass distilled water were blended at high speed for 3 minutes and vacuum filtered through No. 2 Whatman filter paper. The juice extract was analyzed before freezing for all nonsugar components. GLC sucrose and glucose determinations were made on the same juice after it was stored at -30° C for some time.

II Same as Juice I except the juice was frozen immediately at -30° C and later analyzed for all components.

III Prepared as Juice I except boiling water was used in place of room temperature water. Nonsugar component analyses were made on Entry No. 5 only, before freezing. GLC sucrose and glucose analyses were made also on No. 5 entry juices after it was stored at -30° C but since the results showed no difference from Juice IV, discussion of Juice III is not included in this report.

IV Same as Juice III, except prepared on all entries. Juice was immediately frozen after preparation and all analyses were made after storage at -30° C.

V Juice, extracted from the brei through four layers of cheese cloth, was limed with calcium oxide (CaO). Phosphated thin juice was prepared from the extracted juice by the Corruthers and Oldfield method and frozen at -30° C until analysis.

VI Equal parts (W/W) of brei and glass distilled water were blended and the juice extracted from the resulting slurry by use of a juicerator (Acme model 6001)[1]. The extracted juice was frozen immediately at -30° C and analyzed later.

VII Each brei sample was frozen in a double plastic bag at -30° C. Later, the brei was thawed and the juice extracted with a juicerator the same as Juice VI.

VIII A lead defecated juice resulting from the fresh brei sucrose determinations by the standard Sachs-le Docte procedure. The lead defecated juices were frozen until analysis.

Thin juice purity of each juice extract, except Juice VIII, was determined by the standard procedure. Extract polarizations were made by the 100-110 dilution method using 56° brix lead acetate. Using these polarizations to calculate the sucrose concentration in each juice, all nonsugar components were calculated to milligrams (mg) per 100 pol sucrose. The GLC sucrose was calculated to percent and the glucose was calculated to percent based on 100 pol sucrose.

GLC sucrose determinations were made on a dual column Hewlett Packard gas chromatograph, Model No. 5712A[1], fitted with a thermal conductivity detector, an automatic sampler, an integrator, and a recorder. Helium (He) gas was used as the carrier gas. The 1/8 inch stainless steel columns were packed with 10% OV 17 (phenylmethyl-silicone) liquid phase on Chromosorb W-AW-DMCS (acid washed and treated with dimethyldichlorosilane), 80-100 mesh. We found the columns had higher sensitivity and were more stable when they were conditioned before use for about 48 hours at 100° C with a low He flow (10-15 ml/min) with the detector end of the column disconnected allowing the impurities to be expelled in the oven. Just before use, the column temperature was increased to 290° C for about 30-60 minutes to drive off any additional impurities. Analyses were made at the following conditions:

Column temperature: 265° C
Injection port temperature: 250° C
Detector temperature: 300° C
Integrator sensitivity setting: position 3
Detector sensitivity setting: position 6
Helium flow rate: 30 ml/minute
Sample size: 1-1.5 microliters (µl)
Analysis and integration time: 12 minutes
Integration attenuation setting: 1

[1]Mention of a proprietary product does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture.

D(+)-trehalose (dihydrate) was used as the internal standard in the sucrose standards and sugarbeet juice samples. The sugarbeet juice sample aliquots, containing known amounts of the internal standard, were dried before silylation with the aid of acetone, heat, and air. DMF (dimethyformamide) was used as a drying agent along with the silylation agent TMSI (trimethylsilylimidazole) for preparation of the sucrose standard and sugarbeet juice samples.

Glucose was determined colorimetrically by the glucose oxidase method.

Results and Discussion: The pol and GLC sucrose readings and glucose content were all lower at the high N fertility level than at the low N fertility level. However, the analysis of variance showed the difference was not significant. In several cultivars, the cultivar means showed slightly higher glucose at the higher N fertility level, but the Ovana fodder beet (Entry 10) juices and the F_1 Ovana hybrid (Entry 6) juices contained more glucose at the lower N fertility level. Their pol sucroses were higher than GLC sucroses, but not significantly.

N Treatment	Pol sucrose	GLC sucrose	Glucose
Low N	6.36%	6.32%	1.39%
High N	6.29	6.19	1.35

The overall means for each type of juice (next table) showed only two significant differences between pol and GLC sucrose readings; those were juices V and VIII. These two differences have possible explanations. Juice VIII (leaded filtrate) had an actual pol sucrose concentration of 1.87% while its GLC sucrose was 1.62%. This would indicate that dextrorotatory compounds were present, inflating the rotation. Juices I, II, IV, and VII (water extracts) also had higher pol than GLC sucroses, but were not significant. It would appear that leaded filtrate and water extracts of brei all contained dextrorotatory compounds which resulted in a slightly higher measure of sucrose than was actually present. Juice V (synthetic thin juice) on the other hand had lower pol than GLC sucrose. The thin juice preparation is rather rigorous, high pH and temperature, which obviously degraded most of the glucose, probably degraded all the fructose, and undoubtedly converted considerable of the glutamine and glutamic acid to PCA (PCA has an optical rotation of -11.9°). The combination of these changes and possibly others may be the reason for the lower pol sucrose determinations. If this is true, then synthetic thin juice purities would be lower than true purities.

As noted in the table, glucose was obviously degraded in the preparation of Juice V, so that the ratio of pol sucrose to glucose

was 22.96:1. On the other hand, this ratio in Juice VIII was 2.37:1. Hence, it would appear that there may have been some inversion of sucrose during the preparation of the lead defecated filtrate. The pol sucrose to glucose ratio of the water extracts were more or less similar, ranging from 3.64:1 to 5.02:1.

Juice	Sucrose Pol	Sucrose GLC	Difference from pol suc.	Glucose (%/100 suc.)	Ratio of pol sucrose to glucose
I	7.20% b	6.97% bc	-0.23%	1.79% b	4.02:1
II	6.96 c	6.79 c	-0.17	1.91 a	3.64:1
IV	7.19 bc	7.00 bc	-0.19	1.70 bc	4.23:1
V	6.43 d	6.80 c	+0.37**	0.28 f	22.96:1
VI	7.04 c	7.17 b	+0.13	1.60 cd	4.40:1
VII	7.58 a	7.45 a	-0.13	1.51 d	5.02:1
VIII	1.87 e	1.62 d	-0.25*	0.79 e	2.37:1

The pol and GLC sucrose and glucose means for each cultivar are shown in the next table. Considerable difference is noted in the sucrose content of the juices from the different cultivars. This is to be expected since the cultivars were selected to give a wide range in juice sucrose content and purity. The pol sucrose mean for each cultivar was higher than the GLC sucrose mean except for entry 7 (Fort Collins 3-way hybrid) in which the GLC sucrose was slightly higher. In several instances, the difference between the two sucroses was minimal as shown in the table; none of the differences were significant. The difference in the pol and GLC sucrose means did not correspond always to the proportionate amount of glucose present which may indicate the presence and effect of other rotatory compounds, depending on entry. The Ovana fodder beet (Entry 10), as expected, gave very low sucrose readings but it was surprising to see the large amount of glucose present, as indicated by the glucose mean. The F_1 Ovana hybrid (Entry 6) also showed a relatively large amount of glucose when compared to the sucrose content but not as much as the Ovana fodder beet. This might indicate that the fodder beet has the capability to carry photosynthate to the monosaccharide stage but not on to high disaccharide levels.

Entry no.	Cultivar	Sucrose Pol	Sucrose GLC	Difference from pol sucrose	Glucose	Ratio pol sucrose to glucose
1	US H9B	6.49% cd	6.48% c	-0.01%	0.78% c	8.34:1
2	US H20	6.26 d	6.06 d	-0.20	1.30 b	8.82:1
3	HH 10	6.83 abc	6.76 bc	-0.07	0.79 c	8.63:1
4	GW 359-56R	6.95 ab	6.79 bc	-0.16	1.10 bc	6.32:1
5	GW Mono Hi	7.08 ab	7.03 ab	-0.05	0.81 c	8.77:1
6	F_1 Ovana Hyb.	5.20 e	5.18 e	-0.02	1.34 b	3.89:1
7	FC 3-way Hyb.	7.21 a	7.28 a	+0.07	0.82 c	8.76:1
8	F_1 hyb.,high pur.	6.74 bc	6.72 bc	-0.02	0.93 c	7.26:1
9	F_1 hyb.,high pur.	6.99 ab	6.90 b	-0.09	0.82 c	8.47:1
10	Ovana	3.51 f	3.39 f	-0.12	4.99 a	0.70:1

An analysis of variance was performed on the data as indicated in the following table. As mentioned earlier, there was no significant differences between the two N fertility levels for either the pol or GLC sucrose or for glucose. There was a highly significant difference between cultivars and between the different types of juices for all three determinations. The interaction between cultivars and juices (C X J) was highly significant for all three characters, but all other interactions were not significant.

Source of variance	Degrees of freedom	% Sucrose		% Glucose
		Pol	GLC	
Reps	4	NS	NS	NS
N level (N)	1	NS	NS	NS
Error A	4			
Cultivars (C)	9	**[1]	**	**
N X C	9	NS	NS	NS
Error B	72			
Juices (J)	6	**	**	**
N X J	6	NS	NS	NS
C X J	54	**	**	**
N X C X J	54	NS	NS	NS
Error C	480			
Total	699			

[1]Significant difference at the 1% level.

Overall, this experiment did not clearly indicate that any one type of juice is superior for comparison of GLC and pol sucrose determinations to insure a constant ratio between the two. Juices VI and VII (centrifugal juicerator extracts) showed the least difference between GLC and pol sucroses. The difference between GLC and pol sucrose in the lead defecated filtrate (Juice VIII) was the greatest of all juices. Juice VIII also contained the highest proportion of glucose which possibly contributed to the higher pol sucrose reading. The experiment does show that lead defecated filtrate, which is the standard tare lab juice for sucrose determination, does give a higher measure of sucrose than determined by gas chromatography.

Quality and Nonsugars as Affected by Sample Preparation

R. J. Hecker and G. W. Maag

A previous experiment, reported in 1972, had indicated that preparation and handling of sugarbeet juice samples resulted in some quantitative differences in nonsugars and purity. Briefly, freezing of extracts (1 brei:1 boiling water) resulted in increased clear juice purity, nitrate, amino N, and total N, and decreased chlorides and conductivity. The purpose of the experiment being reported herein was to expand the methods of sample preparation, introduce fertility and cultivar differences, and study their effect on quality and quantity of nonsugars in the different juice samples.

Materials and Methods. This field grown experiment involved two nitrogen fertility levels, optimum (80 lbs applied N/A), and excess (200 lbs applied N/A), 10 cultivars (ranging from commercial sugarbeet to fodder beet), seven juices, and 10 replications, for a total of 1400 samples. The 10 cultivars and seven juices are listed and described in the preceding report section.

Results and Discussion. Each plot sample of beets (about 24 roots) was weighed and sucrose was determined on the brei from which all the juices were made. Brei sucrose, after freezing, was also measured on that portion of the brei which was frozen and used to make juice 8. All sucrose determinations were made on a manual saccharimeter. Table 1 reports plot weights and compares the sucrose of fresh brei with brei frozen at -29° C for 19 days. Root yields increased with added nitrogen, with the exception of cultivar 2. The sucrose content of both fresh and frozen brei decreased with added nitrogen, with the exception of cultivar 6, which was the sugarbeet X fodder beet hybrid. However, the fodder beet itself, cultivar 10, had lower sucrose under high nitrogen. These interactions were not significant. Except as noted, increased nitrogen affected root yield and sucrose as expected. The sucrose of fresh and frozen brei was not different. This concurs with a similar comparison which we reported in 1971. Therefore, freezing brei appears to have no effect on the polarization of its resultant lead defecated filtrate.

The nine characters determined on the different juices were not as consistent as brei sucroses. The analyses of variance results in Table 2 showed significant differences in the relative quantities of nonsugars due to nitrogen fertility levels, cultivars, and juices. One would expect N levels and cultivars to be important factors in the quantity of nonsugars, so their significant effects are not surprising. However, differences between juices means that the quantity of eight characters in Table 2 depends on the manner in which the juice was extracted, since all the characters except purity and sucrose were adjusted to mg/100 sucrose.

An examination of the means in Table 3 shows us which of the juices or cultivars caused the significant F values in Table 2.

We note that our standard method of purity determination (juice 5, limed pressed juice stored frozen for ±4 weeks), resulted in a significantly different purity than several of the other juices. These differences between purity means for juices are somewhat vexing and confusing, and some seem inexplicable. But each of these six purity values is the mean of 200 samples, so they cannot be dismissed lightly. In a 1971 experiment reported in 1972, all extracts were made with boiling distilled water; the purities of frozen extracts were higher than the same extracts analysed immediately. In this 1972 experiment, freezing of hot water extracts caused no significant purity difference (juice 4 at 93.5 vs. 3 at 94.3; juice 3 having been made only from cultivar 5 because of inability to make all the immediate analyses required in both juices 1 and 3). The freezing of cold water extracts caused no difference either, juice 1 (immediate analysis) at 93.16 vs. juice 2 (extract frozen before analysis) at 93.37%. There was, therefore, a difference between years, 1971 and 1972. Our purity analysis method was the same both years, so we have no explanation for this interaction with years. We do have a 1973 experiment comparing purities of fresh and frozen cold water extracts which we hope will help resolve this year interaction, but we have not yet completed the analyses of these data.

The purities of cold water extracts (juices 1 and 2) were 93.16 and 93.37, while the hot water extract (juice 4) had 91.36% purity. This says hot water extraction affected purity downward and/or cold water affected it upward. We have no similar comparisons in other years.

Centrifugal extraction (juice 6) frozen prior to purity analysis was almost ridiculously high at 96.98%, especially when compared to juice 7 (centrifugal extraction from frozen pulp) which had 93.0% purity. In the 1971 experiment, there was no purity difference between frozen brei and frozen pulp extracts, both extracted by blending and vacuum filtration. It is difficult to see how, in 1972, there could have been such an interaction caused by centrifugal extraction vs. blending and vacuum filtration.

The sucrose content of the juices also varied from juice to juice. Less sucrose in juices 5 and 8 is due to dilution. Differences among juices 1, 2, 4, 6, and 7 would have to be due to different degrees of sucrose extraction from the pulp and/or loss of sucrose after extraction due to inversion, bacterial action, etc. But sucrose loss does not seem likely since there was no real opportunity. The low sucrose of juice 2 concurs with our 1971 results. The high sucrose in juice 7 may have resulted from a more complete extraction due to freezing action on the pulp.

The quantity of nitrate (NO_3) was different in the N treatments and in certain cultivars, as might be expected. NO_3 in the seven juices was not different according to the F test (Table 2), but the multiple range test in Table 3 indicates that there was less NO_3 in the leaded filtrate (juice 8). The lead defecation may have removed some of the NO_3.

The quantity of amino N was different in the N treatments and certain cultivars, as expected. There was some amino N apparently removed in the process of preparing juice 5 and 8. Some differences among the remaining juices were significant which is somewhat vexing since juices 1, 2, 4, 6, and 7 were not purified in any way; they differed only in their manner of extraction and storage. It is most likely that the significantly higher amino N in juice 1 resulted from a more complete extraction.

Total nitrogen was affected by N fertility and cultivar, which is not new or surprising. Juices 1, 2, 4, 6, and 7 are of greatest comparative interest. Juice 1 had significantly more total N than the other four extracts. This may have been a result of the increased amino N. In the preparation of juice 5, some N was apparently removed, while in the preparation of juice 8 there must have been a much more complete extraction of N from the original brei.

Sodium (Na) was most completely extracted from the brei in juices 5 and 8. For the other juices there was no consistent relationship with extraction and treatment.

Potassium (K) had less variability among juices. Only juice 8 had a higher K content. There were, of course, considerable difference among N levels and cultivars.

Chlorides (Cl) and ash were similar in all the juices except the lead defecated filtrate (juice 8), where apparently a significant amount of Cl and total ash was removed in lead clarification.

The differences observed in this experiment in thin juice purity, sucrose, and the nonsugars due to the effect of nitrogen fertility and cultivar were generally as expected. Cultivars 6 and 10 were known to be low quality. However, the determinations on the different juices failed to provide the definitive information for which the experiment was designed. Which is unfortunate, since there is already sufficient confusion on this particular subject without adding more. Our 1973 experiment should help to resolve some of the juice differences in quantity of nonsugars and quality.

The significant first order interactions in Table 2 also need some attention. The cultivar X nitrogen level interaction was significant for all the nonsugars except chlorides. Hence, the relative quantities

of individual nonsugars in the different cultivars differed in the two nitrogen environments. This type behavior has been reported in past experiments, so it is not surprising.

The more important interactions in this experiment are juices X nitrogen levels and juices X cultivars. Those significant interactions in Table 2 tell us that for a specific character, its measure in a particular juice is a function of the cultivar or nitrogen environment. This literally means that one juice may give the most approriate results in one cultivar or at one nitrogen level, but in another cultivar or nitrogen environment another juice may be best. This complicates the problem of deciding on the best single juice or method of sampling for quality and nonsucrose characters.

After studying the main effect and first order interaction means, it appears that juice 1 was the most consistently appropriate juice of all for determinations of the nonsucroses. Juice 1 was an extract from 1 brei:1 distilled H_2O (20° C), blended at high speed for 3 minutes, and vacuum filtered. All analyses were made immediately; this type extract preparation is not usually practical, however. Freezing of this extract for later analysis cannot be recommended, based on the results of this experiment and those in 1971. So, the most practical and best method would appear to be freezing of the brei followed at some later date by extraction and immediate analysis. This conclusion is based on the 1971 and 1972 experiments. Juice extraction from fresh or frozen brei with the centrifugal juicerator does not appear to be a satisfactory extraction method from this 1972 experiment.

Juice 8 (lead defecated filtrate) would be an ideal juice from which to make a quality determination since it is always available from the standard sucrose analysis. In this experiment, juice 8, compared with the water extracts 1, 2, 4, 6, and 7 contained less NO_3 and amino N, but more total N. This must mean that more N was extracted from the brei in the preparation of juice 8 than in the preparation of the water extracts. In the same preparations more NO_3 and amino N must have been removed from juice 8. There also must have been a much more complete extraction of Na and K in juice 8. But, Cl and total ash must have been less completely extracted in juice 8 and/or partly removed in the lead acetate clarification process. We are still hopeful that we can find a good functional relationship between some set of easily determinable characters in the leaded filtrate which will serve as a quality index which is equally as good as synthetic thin juice purity. We are working in this area, but have not yet completed the modeling and model testing.

Table 1. Root yield, fresh brei sucrose, and frozen brei sucrose of 10 varieties at two nitrogen fertility levels.

Variety	Root yield (Kg/plot)		Fresh brei sucrose %		Frozen brei sucrose %	
	80 lb N/A	200 lb N/A	80 lb N/A	200 lb N/A	80 lb N/A	200 lb N/A
1. US H9B	17.6	18.4	15.1	14.2	14.9	14.1
2. US H20	16.8	16.1	14.4	13.4	14.2	13.5
3. HH 10	17.0	18.3	15.8	15.0	15.5	14.4
4. GW 359	15.4	16.4	15.9	15.4	15.6	15.4
5. GW Mono Hi	18.2	18.5	16.3	15.6	16.1	15.5
6. 52-305 X Ovana	14.2	16.6	11.4	11.6	11.5	11.8
7. 3-way exp.hyb.	15.3	16.6	16.3	15.5	16.0	15.5
8. High pur. F_1 hyb.	13.3	15.2	14.9	14.6	14.9	14.3
9. High pur. F_1 hyb.	14.3	16.0	15.2	14.6	15.0	14.3
10. Ovana (fodder)	19.2	22.0	8.0	7.2	8.0	7.0
Mean all varieties	16.1	17.4	14.3	13.7	14.2	13.6
LSD (.05)	1.5	1.5	.7	.7	.8	.8

Table 2. Split-split plot analyses of variance of nine characters in Experiment 6, 1972.

Source of variation	df	sucrose	NO_3	Amino N	Total N	Na	K	Cl	Ash	TJ[1] purity
Reps	9	NS	NS	NS	NS	NS	*	**	NS	NS
Nitrogen level	1	NS	**	**	**	**	**	*	**	*
Error A	9									
Cultivar	9	**	**	**	**	**	**	**	**	**
C X N	9	NS	**	**	**	**	**	NS	**	NS
Error B	162									
Juice	6	**	NS	**	**	**	**	**	**	**
J X N	6	NS	*	**	**	**	NS	NS	NS	NS
J X C	54	**	**	NS	**	**	**	**	**	**
N X C X J	54	NS	NS	NS	NS	NS	NS	NS	NS	NS
Error C	1080									
Total	1399									

*,** designate significance at the 5 and 1% levels, respectively.
[1]Thin juice purity analysis includes only 6 juices; degrees of freedom were reduced accordingly.

Table 3. Means of 9 characters over N levels, entries and juices, 1972. Means followed by the same letter are not different (5% significant level).

Main effect	Thin juice purity (%)	% Sucrose of extract	mg/100 sucrose						
			NO_3	Amino N	Total N	Na	K	Cl	Ash
Juice									
(1) 1:1 ext.	93.16 c	7.14 b	154.4 a	119.7 a	647.2 b	273.3 d	722.5 b	97.2 ab	3283 b
(2) 1:1 ext. froze	93.37 c	6.97 c	150.6 ab	111.7 b	608.0 c	267.3 d	721.6 b	94.6 b	3276 b
(4) 1:1 hot ext. froze	91.36 d	7.06 bc	155.2 a	111.9 b	597.5 c	292.8 cd	740.6 b	98.3 ab	3369 b
(5) thin juice	95.83 b	5.75 d	166.6 a	86.3 c	278.3 d	354.3 b	709.8 b	104.0 a	3228 b
(6) 1:1 cent. ext. froze	96.98 a	7.00 bc	163.1 a	113.5 ab	579.8 c	317.1 c	723.5 b	104.6 a	3458 b
(7) 1:1 froze pulp cent. ext.	93.00 c	7.51 a	162.9 a	108.2 b	591.0 c	291.6 cd	709.0 b	100.8 ab	3244 b
(8) leaded filtrate		1.82 e	120.3 b	95.8 c	806.6 a	495.8 a	883.9 a	47.4 c	21695 a
Applied N									
(1) 80 lbs	94.50	6.22	77.9	77.0	495.3	277.0	712.8	96.8	5632
(2) 200 lbs	93.39	6.13	228.7	136.5	678.6	377.9	776.0	88.0	6241
Entry									
(1) US H9B	95.07 a	6.39 d	106.8 bc	86.8 e	500.7 d	224.5 d	678.2 c	48.1 c	5220 c
(2) US H20	95.44 a	6.11 e	65.2 c	80.2 ef	493.5 d	305.5 bc	469.3 e	51.9 c	5109 c
(3) HH 10	94.89 a	6.75 bc	59.9 c	104.6 cd	552.6 c	210.1 d	547.5 de	49.9 c	4750 cd
(4) GW 359	95.58 a	6.94 ab	54.4 c	110.2 c	586.7 c	199.8 d	610.8 cd	47.3 c	4632 cd
(5) GW Mono Hi	95.69 a	7.06 a	46.9 c	114.4 c	582.6 c	164.1 d	609.1 cd	35.7 c	4655 cd
(6) 52-307 CMS X Ovana	91.79 b	5.12 f	169.5 b	145.2 b	659.6 b	374.6 b	1086.1 b	124.2 b	7525 b
(7) 3-way hyb.	95.67 a	6.97 ab	48.8 c	91.8 de	556.4 c	178.0 d	539.6 de	37.1 c	4416 d
(8) F_1 hyb.	96.04 a	6.55 cd	30.5 c	58.2 g	446.9 e	242.6 cd	479.3 e	42.7 c	4821 cd
(9) F_1 hyb.	95.81 a	6.58 cd	30.5 c	67.0 fg	480.7 de	181.7 d	508.5 e	41.0 c	4659 cd
(10) Ovana	83.52 c	3.34 g	920.6 a	209.0 a	1009.5 a	1193.8 a	1915.7 a	446.5 a	13573 a

The Effect of Freezing on GLC Sucrose Determinations Made on Sugarbeet Juice Extracts

G. W. Maag

Since it is impossible to analyze only fresh sugarbeet samples because of laboratory work load, the question continually arises as to what effect methods of preparation and storage have on the analytical results. This experiment was undertaken to determine the effect, if any, of freezing on the sucrose content of sugarbeet samples. Since polarimetric sucrose readings are affected, to some extent, by varying amounts of other rotatory compounds found in sugarbeet juices, the sucrose determinations were made by gas liquid chromatography (GLC).

Materials and Methods. Two genetically different cultivars were field grown in a split plot design; main plots were two nitrogen (N) fertility levels: low N (0 lbs applied N/acre), and high N (200 lbs applied N/acre, 100 lbs N/acre preplant and 100 lbs N/acre side dressed post thinning). Sub-plots were the two cultivars; there were 12 replications. Description of the cultivars follows:

Entry 1 52-305 CMS X 52-307, F_1

Entry 2 662094s1-CMS (B_2) X FC 702/2

At harvest time, well blended brei was prepared from each replicate sample and divided. Portion one of each brei sample was blended with equal parts (w/w) of room temperature glass distilled water and filtered through Whatman No. 2 filter paper with the aid of vacuum. The juice extract obtained was divided. One aliquot was used immediately to prepare samples for GLC sucrose analysis. The second aliquot was frozen immediately at -30° C and stored for about 2 weeks. After which it was thawed and GLC sucrose samples prepared. The second portion of brei from each sample was placed immediately after preparation in a double plastic bag, flattened, and frozen at -30° C. Two weeks later, the brei samples were thawed, mixed with equal parts of glass distilled water (w/w), blended, and filtered as before. GLC samples were prepared from the juice extracts immediately.

D(+) trehalose (dihydrate) was used as the internal standard in the sucrose standard and sugarbeet juice extract samples. Small aliquots of weighed sugarbeet juice samples, each containing a known amount of trehalose, were dried, before silylation, in small sampler vials at about 40° C with the aid of acetone and a small jet of air topping each sample. After drying, each sample was treated with dimethylformamide (DMF), a drying agent, and the silylating agent, N-trimethylsilylimidazole (TMSI), in the ratio of 1:2. The vials were sealed and warmed at about 30-40° C for 30-60 minutes or until silylation was complete.

Duplicate samples were analyzed for sucrose on a dual column Hewlett Packard Gas Chromatograph, Model No. 5712A[1], fitted with a thermal conductivity detector, an automatic sampler, an integrator, and a recorder. The ¼ inch stainless steel columns were packed with 10% OV 17 (phenylmethylsilicone) liquid phase on Chromosorb W-AW-DMCS (acid washed and treated with dimethylchlorosilane), 80-100 mesh. Helium (He) gas was used as the carrier gas. Analysis conditions were:

Column temperature: 265° C
Injection port temperature: 250° C
Detector temperature: 300° C
Integrator sensitivity setting: position 3
Detector sensitivity setting: position 6
Helium flow rate: 30 ml/minute
Sample size: 1-1.5 microliters (µl)
Analysis and integration time: 12 minutes
Integration attenuation on 1

Results and Discussion. The GLC sucrose means for each sugar-beet juice extract for each cultivar, low and high N fertility levels, were as follows:

Entry no.	Nitrogen fertility	% GLC Sucrose		
		Fresh J. extract	Frozen J. extract	Extract from frozen brei
1	Low	8.37%	8.40%	8.40%
	High	8.19	8.18	8.19
2	Low	8.92	8.92	8.89
	High	8.63	8.62	8.75

The duplicate analyses means (12 replicates) for each entry at each N fertility level showed little, if any, difference in sucrose percent among the three juice extracts for either entry. The greatest difference was 0.12% between the fresh juice extract sucrose and the frozen brei juice extract sucrose for Entry 2, high N level. We might attribute this difference to increased rupturing of cells during freezing of the brei and thus releasing more sucrose, but since only one of the frozen brei extracts showed the increase, we would question this reasoning. As expected, the sucrose content was higher at the lower N fertility level in each juice treatment for each entry.

Apparently, the freezing and thawing process caused no detectable change in the sucrose content. Perhaps if the samples had been stored at a temperature just below freezing, more change in the sucrose might

[1]Mention of a proprietary product does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture.

have occurred. A temperature of -30° C is sufficiently low for no enzymatic activity to take place. In this experiment, the samples were stored at -30° C because that is the temperature maintained in our storage freezer at our Crops Research Laboratory.

Overall, this experiment showed that storing either brei or extracted juice at -30° C had no significant effect on the sucrose content determined by GLC analysis.

Sugars, Amino Acids, and Related Compounds in Sugarbeet Factory Processing Juices

G. W. Maag and R. J. Hecker

This was a cooperative study with Mr. George Sisler, Analytical Research and Process Development Supervisor, The Great Western Sugar Company.

In 1971, a cooperative study of sugarbeet factory processing juices was made with Mr. Pete Hanzas (deceased) and Mr. John Hobbis, Managers of Chemical Research, American Crystal Sugar Company. The initial study included determination of most of the nitrogen components in the juices and changes in those components during processing. The purpose of the study being reported here was to compare the polarimetric and gas liquid chromatographic sucrose determinations, and to study the resultant effect that the glucose and the amino acids and related compounds may have on the polarimetric sucrose readings. The changes, during factory processing that the individual components undergo, were also observed.

Material and Methods: Nine samplings of five sets of different factory processing juices were collected during December in the 1972 Fall Campaign at the Great Western Sugar Company factory, Greeley, Colorado. The five processing juices were: diffusion juice (or raw juice), thin juice, thick juice, standard liquor, and molasses.

During factory processing the sugarbeets are entered into the factory, washed to remove adhering soil, and sent over a "picking table" where stones and other debris are removed. The washed beets are sliced into thin shoestring-like strips, called cossettes. The cossettes are directed to a diffuser where sugars and soluble nonsugars are removed by diffusion under a high (up to 75° C) temperature condition. The proteins in the cell walls are denatured, thus allowing uninhibited diffusion across the cell membranes. Certain high molecular nonsugars are retained in the cell structure. This step results in the DIFFUSION

or RAW JUICE, usually with an RDS (refractive dry substance) of 12 to 14.

The diffusion juice is taken through several steps to remove more impurities, principally the proteins, some polysaccharide gums, and other compounds which may form insoluble calcium salts. This process is called defecation and is accomplished by liming and carbonation. Carbonation is achieved in a two-step process termed 1st and 2nd carbonation. The 2nd carbonation juice is treated with sulfur dioxide, 500-700 ppm initially. The juice, after sulfitation, is termed THIN JUICE.

The thin juice is sent to a series of evaporators. Water is removed in a quintuple effect evaporation system. The RDS of the resulting THICK JUICE usually ranges between 60 and 66.

The thick juice is combined with remelt sugars from the high raw and low raw pans and filtered. The resulting juice is termed STANDARD LIQUOR, and usually has an RDS of from 66 to 70.

Standard liquor is evaporated in vacuum pans where crystallization occurs. The crystallized product is called white sugar or saleable sugar.

The run-off syrup or liquor from the white pan, high green, is fed to the high raw pan. High green is evaporated so additional crystallization of sucrose occurs. The products from the high raw pan are high raw sugar and machine syrup. Machine syrup forms the feed to the low raw pan. Water is evaporated in the low raw pan so that additional crystallization occurs. The products of low raw crystallization are low raw sugar and MOLASSES. Molasses is the by-product liquor from which no additional sugar can be recovered by crystallization.

The factory processing juice samples were frozen immediately after collection, and stored frozen, until the samples, packed in dry ice, were transported to the Crops Research Laboratory, Fort Collins, Colorado, where they were stored at -30° C until the samples were prepared for analysis.

Polarimetric sucrose determinations and RDS (refractive dry substance) readings were made on the juices at the Great Western Research Laboratory, Loveland, Colorado. The nonsucrose dry substance readings were determined by subtracting the pol sucrose readings from the corresponding RDS value for each sample.

The thick juice, standard liquor, and molasses samples were allowed to come to room temperature and were diluted gravimetrically with glass distilled water before preparation of the samples for amino acid analyses, glucose, and GLC sucrose determinations. The diffusion and thin juice samples were prepared with no dilution.

Small aliquots of each weighed juice sample, each containing a known amount of D(+) trehalose dihydrate (internal standard) were

thoroughly dried, before silylation, in small sampler vials at about 40° C with the aid of acetone and a small jet of air topping each sample. After drying, each sample was treated with dimethylformamide (DMF), a drying agent, and the silylating agent, N-trimethylsilylimidazole (TMSI), in the ratio of 1:2. The vials were sealed and warmed at 40° C for 60 minutes or until silylation was complete.

Duplicate samples were analyzed for GLC percent sucrose on a dual column Hewlett Packard Gas Chromatograph[1], Model No. 5712A, fitted with a thermal conductivity detector, an automatic sampler, an integrator, and a recorder. The ¼ inch stainless steel columns were packed with 10% OV 17 (phenylmethylsilicone) liquid phase on Chromosorb W-AW-DMCS (acid washed and treated with dimethylchlorosilane), 80-100 mesh. Helium gas was used as the carrier gas. Analysis conditions were:

Column temperature: 265° C
Injection port temperature: 250° C
Detector temperature: 300° C
Integrator sensitivity setting: position 3
Detector sensitivity setting: position 6
Helium flow: 30 ml/minute
Sample size: 1 to 1.5 microliters (µl)
Analysis and integration time: 13 minutes
Integration attenuation on 1

The GLC percent sucrose was calculated in relation to standard sucrose-trehalose readings which were made after each set of four duplicate samples.

Glucose was determined on duplicate samples colorimetrically by the glucose oxidase method.

Twenty individual amino acids, two amides, and ammonia were measured quantitatively on duplicate samples, before and after basic hydrolysis using a Technicon Amino Acid Analyzer[1]. The basic hydrolysis was done at a pH of 12 to 13 (NaOH) in a boiling water bath for 3-4 hours. During the basic hydrolysis the amides, glutamine (GLN) and asparagine (ASN), along with any pyrrolidone carboxylic acid (PCA) present, were converted to their respective amino acids; GLN and PCA to glutamic acid (GLU), and the ASN to aspartic acid (ASP).

Before basic hydrolysis, the serine (SER), GLN, and ASN were eluted on the amino acid analysis chromatogram as occluded peaks. The resulting occluded peak was measured quantitatively using SER as the standard. After hydrolysis, the SER peak was only SER, since the GLN had been converted to GLU, and ASN had been converted to ASP. Any PCA, present before the basic hydrolysis, was hydrolyzed to GLU. Therefore, the GLU peak, after hydrolysis, was the result of the original GLU, plus the original

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GLN and PCA. To calculate the ASN, SER, GLN, and PCA, therefore,

1. ASP (after hydrol.)-ASP (before hydrol.) = ASN (in the original sample)
2. SER (occluded peak before hydrol.) = SER + GLN + ASN
3. SER (before hydrol.)-SER (after hydrol.) = GLN + ASN
4. GLN + ASN (step 3)-ASN (step 1) = GLN (before hydrol.)
5. GLU (after hydrol.)-GLU (before hydrol.) = GLN + PCA
6. GLN + PCA (step 5)-GLN (step 4) = PCA in original sample

All amino acids, amides, ammonia, and glucose were calculated to micromoles (μm) per 100 pol sucrose and per 100 nonsucrose dry solids. Means for nine replicates for each chemical component, percent sucrose, RDS, and nonsucrose dry substance were also determined.

Results and Discussion. The table below gives the nine replicate means for the pol and GLC percent sucrose, the RDS (total solids), and the nonsucrose solids for each factory juice.

Component	Diffusion J.	Thin J.	Thick J.	Standard liquor	Molasses
% Sucrose					
Pol	12.72	11.56	59.68	64.14	52.51
GLC	12.30	11.11	58.72	61.58	49.83
RDS					
Total	14.58	12.59	64.98	67.99	80.08
Nonsucrose	1.86	1.03	5.30	3.85	27.57

In each factory juice the pol sucrose was higher than the GLC sucrose. This was probably due to the effect on the polarimetric readings of other substances in the juices. Sucrose is dextrorotary, $[\alpha]_D^{20}$ = +66.5°, as are glucose, $[\alpha]_D^{20}$ = +92.3°, raffinose $[\alpha]_D^{20}$ = +104.5°, and a few other sugars possibly present. Some additional components, such as amino acids and amides, found in the juices are dextrorotary and some are levorotary. Apparently, from comparison of the pol and GLC sucrose values, it would appear that there was a greater resultant effect on the polarimetric sucrose readings from the dextrorotary compounds than from the levorotary compounds. Glucose is partially destroyed during processing, and fructose, $[\alpha]_D^{20}$ = -92.3°, is probably almost totally destroyed because of its instability, but raffinose is quite stable and apparently is carried through the juices during processing. Raffinose is especially troublesome if sugarbeets have been stock piled at cool temperatures for a period of time, not only because of its high dextrorotary optical activity, but because of its adverse effect on the rate of sucrose crystallization.

Tables 1 and 2 list the milligrams (mg) of individual amino acids, amides, PCA, and ammonia per 100 pol sucrose and per 100 nonsucrose,

respectively. Also given in Table 1 is the glucose content of each juice in mg per 100 pol sucrose and the specific rotation of each component except for GLY, GABA, and ammonia. These three contain no assymetric carbon, and, therefore, are not optically active.

Table 1. Five factory processing juice means (9 samplings) for amino acids, amides, PCA, ammonia, and glucose in milligrams per 100 pol sucrose, and the specific rotation of each component.

Component	Specific rotation	Diffusion J.	Thin J.	Thick J.	Standard liquor	Molasses
*1. ASP	+ 4.7°	158	140	179	146	861
2. ASN	- 9.3	112	67	101	37	165
3. THR	-28.3	12	10	10	6	10
4. SER	- 6.8	96	87	115	74	557
5. HOMOSER	-27.0	4	3	4	3	35
6. GLU	+31.4	70	205	284	188	1108
7. GLN	+ 6.1	383	150	85	36	114
8. PCA	-11.9	816	920	1319	918	3880
9. PRO	-85.0	16	29	22	18	169
10. GLY	None	7	16	21	19	154
11. ALA	+ 8.5	72	68	90	65	492
12. VAL	+22.9	39	36	48	36	312
13. MET	- 8.2	16	9	17	12	63
14. ILE	+11.3	71	66	88	64	482
15. LEU	+15.1	72	64	87	62	460
16. TYR	-10.6	52	127	192	116	651
17. PHE	-35.1	8	7	10	8	81
18. GABA	None	304	204	254	174	1031
19. ORN	+11.5	3	1	1	1	3
20. LYS	+14.6	10	8	11	8	60
21. HIS	-39.7	13	6	8	4	5
22. TRP	-31.5	24	14	28	21	150
23. ARG	+12.5	14	7	8	5	32
24. NH_3	None	14	65	4	15	11
25. GLUCOSE	+52.7	Not det'm	227	150	98	387

*1. aspartic 2. asparagine 3. threonine 4. serine 5. homoserine 6. glutamic 7. glutamine 8. pyrrolidone carboxylic acid 9. proline 10. glycine 11. alanine 12. valine 13. methionine 14. isoleucine 15. leucine 16. tyrosine 17. phenylalanine 18. gamma amino butyric acid 19. ornithine 20. lysine 21. histidine 22. tryptophan 23. arginine 24. ammonia

Glutamic acid, GABA, aspartic acid, serine, and tyrosine were the amino acids present in the largest quantities in all juices. The two amides, glutamine and asparagine, also ranked high in relative amount; each decreased as the juices progressed through the factory processing. The asparagine converts to its respective amino acid, aspartic, and glutamine is partially converted to glutamic acid, but mainly to PCA.

The PCA, therefore, increased in quantity during processing. When the components are calculated to mg based on 100 pol sucrose, the relative quantities appear to be very high in molasses. This is partially due to evaporation of water during the purification and crystallization processes. Also, since the sucrose content has been reduced by crystallization before it reaches the molasses stage, the comparative amount of other components is higher.

Table 2. Five factory processing juice means (9 samplings) for amino acids, amides, PCA, and ammonia in milligrams per 100 nonsucrose solids.

Component	Diffusion J.	Thin J.	Thick J.	Standard liquor	Molasses
*1. ASP	1078	1576	2016	2424	1640
2. ASN	793	745	1113	631	318
3. THR	82	118	109	96	20
4. SER	658	976	1299	1234	1061
5. HOMOSER	24	37	44	43	66
6. GLU	478	2303	3195	3124	2111
7. GLN	2414	1136	941	2387	148
8. PCA	6570	12,272	16,934	15,532	8560
9. PRO	106	323	243	293	322
10. GLY	50	177	232	316	294
11. ALA	491	764	1008	1078	937
12. VAL	268	409	537	607	594
13. MET	110	97	192	194	120
14. ILE	486	737	997	1075	918
15. LEU	494	724	977	1041	876
16. TYR	355	1421	2162	1940	1240
17. PHE	56	84	109	129	154
18. GABA	2080	2295	2863	2902	1964
19. ORN	20	15	15	22	7
20. LYS	69	92	122	131	114
21. HIS	90	70	86	75	9
22. TRP	162	157	309	350	285
23. ARG	98	84	94	90	60
24. NH_3	98	73	83	258	21

*See Table 1.

When the components are calculated to mg per 100 nonsucrose (Table 2), the comparative amount of each component in molasses is smaller because the relative amount of nonsucrose solids has been increased due to the evaporation process and to crystallization of some of the sucrose. Partial degradation of some amino acids probably has taken place also during processing to cause quantitative changes in those amino acids.

Glucose showed a decrease in the thick juice and standard liquor. Again the relative increase of glucose in molasses appears to be large for the same reasons as mentioned above. Some increase may be due also to a small amount of sucrose inversion since the hold period of the juices during the later stages of processing may be quite long.

By definition, specific rotation, $[\alpha]_D^{20}$, of a substance is the rotation expressed in degrees which is afforded by 1 gram of that substance dissolved in 1 ml of water (20° C) in a tube 1 decimeter in length. The following table gives a comparative estimate of the total dextrorotary and the total levorotary effect of the optically active measured amino acids, amides, and PCA in each processing juice. These values are based on the optical activity of each times the grams of each per unit volume when calculated to 100 pol sucrose. The estimated dextrorotary effect of glucose for each juice is also given. The comparative values were calculated assuming the specific rotation was the same as it is for the individual component in a pure component - water solution. The amino acids, amides, and PCA give a resultant levorotary effect in each juice.

Component-rotation	Estimated specific rotation				
	Diffusion J.	Thin J.	Thick J.	Standard liquor	Molasses
Amino acids etc.					
Levorotary	-15°	-17	-23	-16	-82
Dextrorotary	+ 9	+11	+15	+10	+64
Glucose					
Dextrorotary	Not determined	+12	+ 8	+ 5	+20
Total effect	- 6	+ 6	0	- 1	+ 2

However, since glucose is dextrorotary, it usually overcomes the resultant levorotary effect due to the amino acids etc. The glucose, in the diffusion juice, was not measured due to the very dark color of the diffusion juice. The total resultant effect of the amino acids etc. and glucose indicates that the dextrorotary effect which caused most of the difference between the pol and GLC sucrose determinations must be due to other dextrorotary compounds. Possibly, the raffinose present in the December processing juices could be mainly responsible.

This experiment showed, in the factory processing juices analyzed, that the pol sucrose was higher in each factory juice than the GLC sucrose. The quantity of some amino acids, amides, and PCA are quite significant and when the estimated total specific rotation effect of them was studied, they apparently have a levorotary effect. This may be good since it overcomes some of the dextrorotary effect on the sucrose polarimetric readings caused by such nonsucrose substances as glucose and raffinose.

GENETIC AND BREEDING STUDIES INCLUDING DISEASE RESISTANCE

Rhizoctonia Resistance Field Research, 1973

R. J. Hecker and E. G. Ruppel

Field studies of Rhizoctonia root rot (*R. solani*) of sugarbeet were conducted at our disease nursery (Warren tract) near the Colorado State University Agronomy Research Center, Fort Collins, Colorado. This is the final year of the BSDF lease on this tract. Our field disease research (both Rhizoctonia and Cercospora leaf spot) will be conducted in 1974 on a new tract of land leased by the BSDF. This land will be designated as the Harmony tract and is located 1½ miles south of the CSU Agronomy Research Center.

The following experiments, in addition to selection areas, were included in the Rhizoctonia test field.

Exp. no.	Description
1R	Methods of inoculation with Rhizoctonia
2R	Rhizoc. evaluation of regional cooperative test
3R	Rhizoc. resistance inheritance study
4R	Rhizoc. resistance comparison of reciprocal crosses and 2n vs. 3n equivalents
5R	Rhizoc. resistance evaluation of breeding developments
7R	Rhizoc. resistance evaluation of miscellaneous lines
8R-12R	Rhizoc. resistance evaluation of contributed lines
13R-19R	Rhizoc. resistance evaluation of progeny lines

Except for experiment 1R, the rosette method was used to inoculate all plants. Dry, ground barley-grain inoculum of *Rhizoctonia* isolate R-9 was used. One-row plots 20 feet long and 22 inches apart were planted May 17. Experiments 1R thru 5R had six replications, 8R-12R had five, and 7R as well as 13R-19R had four. Inoculations were made July 23, except experiment 5R on July 12, and 1R as noted in the report on this experiment. The roots were lifted and individually rated for severity of root rot September 26 thru October 5. The disease index (D.I.) ratings were based on a scale of 0 to 7; 0 = completely healthy, 7 = dead. The percentage of healthy roots (ratings 0 and 1 combined) was also calculated. We consider the disease index to be the best measure of genetic resistance, however, the percentage healthy does provide a better picture of the proportion of essentially healthy roots among the lines tested. Disease severity in 1973 was satisfactory.

Comparison of Rhizoctonia Resistance of Reciprocal Crosses

The possibility exists that Rhizoctonia resistance might be influenced in some manner by cytoplasmic factors. Comparisons of reciprocal crosses of Rhizoctonia resistant X susceptible lines of sugarbeet have never been made. This was a very limited test to compare reciprocal crosses. There were only four reciprocal crosses involved, as outlined in Table 1. The crosses were made using cytoplasmic male sterility or hypocotyl and root color differences. The CMS parents involved were B_7 equivalents. The only significant reciprocal difference was between entries 934 and 933 for % healthy roots. However, 933 was evaluated on only a small number of plants due to a low frequency of F_1 plants, although they were in a competitive stand. The triploid equivalents (entries 932 and 931) of these crosses showed no reciprocal differences. The means of the four susceptible X resistant crosses were not different than their resistant X susceptible reciprocals.

On the basis of these very limited data we must conclude that there are no reciprocal differences for Rhizoctonia resistance. Hence, there would appear to be no cytoplasmic or maternal factors affecting resistance to *Rhizoctonia*.

Table 1. Comparison of disease indices (D.I.) and percent healthy roots in Rhizoctonia resistant X susceptible reciprocal crosses, 1973. (Females are first in each cross.)

Entry no.	Population	D.I.	% healthy
927	52-307 CMS (susc.) X FC 702/5 (resist.), F_1	1.55	48.6
928	FC 702/5 (resist.) X 52-307 (susc.), F_1	1.32	57.2
929	FC 901 (susc.) X FC 702/5 (resist.), F_1	1.63	51.1
930	FC 702/5 (resist.) X FC 901 (susc.), F_1	1.67	48.4
934	52-407 CMS (susc.) X FC 701/4 (resist.), F_1	1.92	40.2 }*
933	FC 701/4 (resist.) X 52-407 (susc.), F_1	2.57	26.5 }*
932	52-407 CMS(2n)(susc.) X FC 701/4(4n)(resist.),F_1	1.43	55.4
931	FC 701/4(4n)(resist.) X 52-407(2n)(resist.)F_1	1.38	58.2
939	52-307 (susc.)	2.47	46.6
937	FC 702/5 (resist.)	.90	73.5
938	FC 901 (susc.)	3.87	22.3
935	52-407 (susc.)	2.35	47.5
936	FC 701/4 (resist.)	.83	67.0
	Mean of susc. X resist. crosses	1.63	48.8
	Mean of resist. X susc. crosses	1.73	47.6

*Denotes significant difference (5%) between the two means.

Comparison of Rhizoctonia Resistance of Diploid, Triploid, and Tetraploid Equivalents

We have converted to the tetraploid condition by colchicine, three of our most Rhizoctonia resistant sugarbeet lines. We will be making a complete study of the effect of ploidy level on resistance to Rhizoctonia root rot in the future. However, the data in Table 1 are the first comparisons of ploidy level differences in Rhizoctonia resistant sugarbeets.

The first three sets of comparisons show no significant differences between diploids and tetraploid equivalents. Hence, four resistant genomes in the tetraploids appear to impart no additional resistance over and above the two resistant genomes in the diploid equivalents.

The two sets of diploid and triploid hybrids at the bottom of the table indicate that the triploid hybrids of a resistant X susceptible cross may be more resistant than the same diploid resistant X susceptible cross. We should, however, discount the differences between entries 931 and 933 because entry 933 was more highly infected than we expected, and it was evaluated on only a small number of plants, as was explained in the report section on reciprocal differences. Also, the difference between entries 932 and 934 is only significant for percent healthy roots. However, these data do show some indication that triploid hybrids where the resistant parent was tetraploid, may be more resistant than the same diploid hybrid. It seems biologically reasonable that two resistant genomes out of three might impart greater resistance than one resistant genome out of two. We plan more extensive experiments on ploidy effect on Rhizoctonia resistance as soon as we synthesize the appropriate resistant X susceptible hybrids.

Table 1. Comparison of disease indices (D.I.) and percent healthy roots in 2n, 3n, and 4n equivalent lines of Rhizoctonia resistant sugarbeets, 1973.

Entry no.	Population	Ploidy level	D.I.	% healthy
955	FC 701/4 (4n) C_2 (resist.)	4n	1.53	64.8
956	FC 701/4 (4n) C_3 (resist.)	4n	1.73	59.6
954	FC 701/4 (2n) (resist.)	2n	1.33	63.6
965	FC 702/4 (4n) C_2 (resist.)	4n	1.57	59.1
964	FC 702/4 (2n) (resist.)	2n	1.47	58.2
971	FC 703 (4n) C_2 (resist.)	4n	1.17	66.1
970	FC 703 (2n) (resist.)	2n	1.30	62.2
	Mean of three 2n's		1.37	61.3
	Mean of four 4n equivalents		1.50	62.4
931	FC 701/4 (4n) X 52-407 (2n), F_1	3n	1.38 }*	58.2 }*
933	FC 701/4 (2n) X 52-407 (2n), F_1	2n	2.57	26.5
932	52-407 CMS (2n) X FC 701/4 (4n), F_1	3n	1.43	55.4 }*
934	52-407 CMS (2n) X FC 701/4 (2n), F_1	2n	1.92	40.2

*Denotes significant difference (5%) between the two means.

Progress in Breeding for Rhizoctonia Resistance

Strains of the soil borne fungus *Rhizoctonia solani* which cause root and crown rot of sugarbeet are apparently indigenous in most sugarbeet production areas of the U.S. Losses from Rhizoctonia root rot have been a perennial problem, although normally not a dramatic one.

Breeding for resistance to this fungus was commenced almost 15 years ago at Fort Collins by John O. Gaskill; he summarized his work in 1968 (J. Amer. Soc. Sugarbeet Technol. 15:107-119). We have continued this breeding effort since his retirement. As in most breeding programs, large numbers of breeding lines have been developed and we have reached the point where we do not have the resources to continue all lines. In Experiment 5R, 1973, we tested the Rhizoctonia resistance of a number of breeding lines to measure the breeding progress, as well as to sort out the most resistant lines for continued effort.

The original resistance selection effort was commenced in GW 674-56C, which was an open pollinated commercial variety of the 1950's, and also in C 817, which was a high sugar yield synthetic developed from GW 359. The FC 701 and FC 702 series of lines have been developed from the above parents, respectively. Table 1 shows the progress made in these two series through seven cycles of mass and mother-line selection. Rhizoctonia resistance has been progressively improved with continued selections and breeding, particularly in the FC 701 series. In the FC 702 series, there appears to have been some loss of resistance in the 7th cycle populations. From a study of individual plant disease ratings, as well as the disease index and % healthy means, we feel that we have not yet achieved an adequate level and homogeneity of resistance. The most resistant lines in Table 1 have about 67% healthy roots. These are roots with disease ratings of 0 and 1 (no infection or small arrested lesions). Even in these best lines, about 33% of all roots have active rot areas; such roots when piled could provide the starting spots for pile rotting organisms to commence. Our goal for resistance is near 100% roots with no active rot at harvest.

In addition to those populations in Table 1, we had in the same experiment a number of other breeding lines many of which are related to FC 701 and FC 702. These additional lines are listed in Table 2. Lines in the FC 703 series show respectible resistance; we will continue to use some of these as breeding lines. Certain of the progeny lines from single plants (entries 986-990) have the most resistance of anything in the test, and will be carried on as breeding lines. These lines as well as all lines in the FC 701, FC 702, and FC 703 series are multigerm and have potential as pollinators for commercial hybrids; however, some improvement in their combining ability for root yield would be desirable or, perhaps, even necessary.

Incorporation of Rhizoctonia resistance into leaf spot (LSR) and leaf spot-curly top (LSR-CTR) resistant germplasm has also been part

of our program. Entries 978-980 (LSR lines) in Table 2 have moderately high Rhizoctonia resistance. Only a few of the LSR-CTR-Rhizoc. lines have potentially useful levels of Rhizoctonia resistance, i.e., entries 995, 996, 991, and 993. However, the combination of Rhizoctonia resistance into LSR and LSR-CTR lines has not yet reached the level we consider necessary for direct use as parental components in hybrids.

Entries 972, 981, and 1000 are superior performing hybrids for yield, sucrose, and purity. They have exhibited a moderate level of Rhizoctonia resistance.

In general, genetic progress toward Rhizoctonia resistance has been steady but not rapid. This is about what we would expect based, first, on our inheritance studies in which we found that there were probably three or more primary genes conditioning resistance; and, second, on our studies and experience of a large environmental influence on expression of the disease. We are now using recurrent selection in breeding for resistance; after progeny testing we use selfed or vegetative propagules of superior maternal genotypes to synthesize the succeeding cycle for selection. We are hopeful that these more sophisticated breeding methods may increase our rate of improvement in resistance. We are also experimenting currently with making selections and progeny tests entirely in the greenhouse to determine if breeding for resistance can be done in the greenhouse. Simultaneous with our resistance breeding, we are attempting to improve the general combining ability of our resistant breeding lines by polycross progeny evaluations under disease free conditions.

Table 1. Progress toward Rhizoctonia resistance as measured by disease index (D.I.) and % healthy roots, 1973. Means followed by the same letter within groups are not significantly different at the 5% level.

Entry no.	Population	D.I.	% healthy
951	GW 674-56C; source of FC 701 series	4.13 a	26.7 c
952	FC 701; 4 cy. sel.	2.05 b	50.4 b
953	FC 701/2; 5 cy. sel.	1.33 c	60.3 a
954	FC 701/4; 6 cy. sel.	1.33 c	63.6 a
958	FC 701/5; 6 cy. sel.	1.23 c	67.3 a
959	FC 701/5; 6 cy. sel.; incr. of 958 w/o sel.	1.22 c	61.5 a
957	FC 701/4; 7 cy. sel.	1.07 c	64.5 a
960	FC 701/5; 7 cy. sel.	1.08 c	66.7 a
961	C 817; source of FC 702 series	3.52 a	27.1 d
962	FC 702; 4 cy. sel.	2.17 b	49.6 c
963	FC 702/2; 5 cy. sel.	1.98 bc	53.9 bc
964	FC 702/4; 6 cy. sel.	1.47 cd	58.2 abc
967	FC 702/5; 6 cy. sel.	1.22 d	64.1 ab
968	FC 702/5; 6 cy. sel.; incr. of 967 w/o sel.	1.15 d	66.5 a
966	FC 702/4; 7 cy. sel.	1.63 bcd	55.7 bc
969	FC 702/5; 7 cy. sel.	1.35 cd	62.0 ab

Table 2. Rhizoctonia resistance evaluation of breeding lines, 1973. Means within groups followed by the same letter are not significantly different at the 5% level.

Entry no.	Population and description	D.I.	% healthy
970	FC 703;(FC 702 X FC 701,F_1); 1 cy.sel. in F_1	1.30 ab	62.2 ab
973	FC 703/1; 2 cy. sel.	1.32 ab	61.0 ab
974	FC 703; 3 cy. sel.	1.68 a	58.8 b
975	FC 703; 2 cy. field sel. & 1 cy. greenhouse sel.	1.22 ab	65.1 ab
976	FC 702/5 X FC 701/5, F_1	1.08 ab	68.5 ab
977	FC 702/5 X FC 701/5, F_2	1.15 ab	65.9 ab
982	Pool of early Rh.res. lines from GW 674 & C 817	1.07 ab	69.0 ab
986	721066 } single plant progeny lines from	0.93 b	70.8 a
987	721067 } pool of early Rh.res. lines	1.17 ab	66.1 ab
988	721068 } from GW 674 & C 817; 3 cy. Rh.	0.98 b	68.9 ab
989	721069 } sel. since progeny test	1.23 ab	68.5 ab
990	721070 }	1.47 ab	60.4 ab
	From leaf spot resistant sources		
978	SP 5831-0; LSR-BRR; 6 cy. Rh.sel.	2.10 a	47.3 a
980	Hetero. LSR-BRR line from SP 5831-0 & GW 674; 3 cy. Rh.sel.	1.57 a	56.2 a
979	Hetero. LSR line from diverse sources; 4 cy. Rh.sel.	1.65 a	52.5 a
	Lines involving LSR-CTR germplasm		
983	(LSR-CTR line X LSR-CTR line) X (FC 702 X LSR-CTR line);1 cy.Rh.sel. since cross	4.38 a	21.0 d
984	[FC 903(LSR-CTR) X (FC 901(LSR-CTR) X 631001-0(2 cy.Rh.sel.)]; 1 cy. Rh.sel. since cross	3.30 b	32.8 c
985	[FC 901(LSR-CTR) X 631001-0(2 cy.Rh.sel.)]; 1 cy. Rh.sel. since cross	3.03 b	32.9 c
994	FC 901 (LSR-CTR) X FC 701/3, F_2	3.00 b	39.3 c
995	FC 901 (LSR-CTR) X FC 702/3, F_2	1.45 c	61.8 a
996	FC 701 X pool of LSR-CTR lines, F_3	1.53 c	60.0 a
997	LSR-CTR pool X FC 701, B_1 to LSR-CTR parent	2.90 b	39.2 c
998	FC 702 X LSR-CTR pool, F_3	2.88 b	34.9 c
991	FC 801; LSR-CTR-Rh.res.	1.90 c	54.7 ab
993	FC 801; sub-line	2.05 c	48.8 b
999	FC 901; LSR-CTR pollinator; no Rh.sel.	4.53 a	21.3 d
	Promising hybrids involving Rh.res. pollinators		
972	681205H00 X FC 702/2	2.15 a	45.0 a
981	(FC 603 X SP 662119s1) X FC 703	2.23 a	44.6 a
1000	662119s1 X FC 703	1.95 a	47.2 a

Rhizoctonia Resistance of Miscellaneous Lines

Various lines of interest in our Rhizoctonia resistance breeding program were tested in Experiment 7R, 1973. Table 1 lists the means for disease index and % healthy roots of these lines.

Table 1. Disease indices and % healthy roots of miscellaneous lines of interest; Experiment 7R, 1973. Means followed by the same letter are not significantly different at the 5% level.

Entry no.	Population	D.I.	% healthy
1009	RR-09-2; Jap. Rh. res. sel. from US 401; 3 cyc. mother-line sel. in Jap.	1.40 kl	53.20 lmn
1010	RR-14-1; do.	2.05 ghijkl	38.58 fghijk
1011	RR-14-3; do.	2.00 ghijkl	41.46 ghijkl
1012	RR-22-4; do.	2.40 fghijk	41.43 ghijkl
1013	RR-22-8; do.	2.43 fghij	39.77 fghijkl
1014	RR-34-5; do.	1.58 jkl	48.54 jklm
1015	RR-34-6; do.	1.85 ijkl	41.67 ghijkl
1016	RR-39-8; do.	1.95 hijkl	37.79 fghijk
1017	RR-39-11; do.	2.03 ghijkl	39.89 fghijkl
1018	SP 72547-0	3.18 cdef	43.06 hijkl
1019	SP 67547-01; CMS	2.10 ghijkl	50.02 klm
1020	FC 701/5; 6 cy. Rh.sel.	1.10 l	64.37 n
1021	SP 67547-01 X FC 702/5, F_1	1.23 l	58.89 mn
1022	SP 67550-01; CMS	3.13 cdef	33.83 efghi
1023	SP 71550-0	2.40 fghijk	45.87 ijklm
1024	SP 67555-01; CMS	2.48 fghij	37.79 fghijk
1025	SP 67555-0	2.03 ghijkl	48.23 jklm
1026	11866 X 12163; CMS, ♀ in US H20	3.73 bcde	20.10 abcd
1027	63-(5HO X 6); CMS, ♀ in Am. #4 Hyb.A	3.88 bcd	18.01 abc
1028	GW-918; CMS, ♀ in GW hybs.	3.15 cdef	34.94 fghij
1029	67MSH154; CMS GW SC ♀ for CA testing	2.85 efghi	36.49 fghijk
1030	H65-02-69; CMS, SC ♀ in Holly hybs.	3.00 defg	32.79 defghi
1031	9399-02; CMS, SC ♀ in Holly hybs.	4.38 b	9.14 a
1032	100363 MS X 12166; CMS, ♀ in U-I hybs.	3.73 cde	18.15 abc
1033	51-338; inbred, MM, ± Aphanomyces res.	5.53 a	17.79 abc
1034	51-319; inbred, MM, stor. rot susc.	5.48 a	15.07 ab
1035	50-620; inbred, MM, stor. rot susc.	3.28 cdef	27.27 bcdef
1036	A58-5 fodder beet; stor. rot susc.	2.05 ghijkl	33.20 defghi
1037	US H9B; CTR, 3-way TC hyb.	4.08 bc	21.05 abcde
1038	US H20; LSR-BRR, 3-way TC hyb.	2.88 defgh	32.50 defghi
1039	GW Mono Hi Al; comm. hyb. for Colo.	3.15 cdef	28.90 cdefg
1040	Am. #2 hyb.	3.18 cdef	27.27 bcdef
1041	FC 506; LSR, mm, T.O. rr	3.00 defg	31.40 defgh

The first nine entries (1009-1017) resulted from three cycles of mother line selection in US 401 by Dr. Hasegawa, Japan Sugar Beet Improvement Foundation, Sapporo, Japan. All nine lines indicated that some progress had been made toward resistance; entries 1009 and 1014 were particularly resistant. Entry 1021 (SP 67547-01 X FC 702/5, F_1) was quite highly resistant, and confirms its 1972 performance; SP 67547-01 is not particularly resistant but it combines well with FC 702/5 for resistance to Rhizoctonia. Entries 1026-1032 are female components of commercial hybrid varieties, and are all relatively susceptible. The Aphanomyces resistant inbred (entry 1033) is the most Rhizoctonia susceptible entry in the test. The yellow fodder beet (entry 1036), which tends to rot in overwinter storage, is surprisingly resistant with a disease index of 2.05.

Effect of Granular Ethephon on Pollen Viability in Sugarbeet

R. J. Hecker and G. A. Smith

In Sugarbeet Research, 1971 Report, we reported on experiments comparing the gametocidal effect of aqueous ethephon (Ethrel) with FW-450, oestrone, and arsenic acid. Ethephon applied as a foliar spray appeared to have little or no practical value as a gametocide on sugarbeet. A report on the use of granular ethephon to reduce pollen production in certain weed species (S. C. Phatak, Abstracts, Weed Sci. Soc. Amer., 1973) prompted us to try this material on sugarbeet.

Two greenhouse experiments were conducted in 1973. In the first experiment, we used mother roots and applied four rates of 5% granular ethephon (200 to 1600 ppm incorporated into soil) at two growth stages (premeiosis and meiosis). Early application at 800 and 1600 ppm killed the plants. Even 200 ppm applied late virtually stopped growth and arrested flower development until about 30 days after treatment, when the ethephon apparently had become degraded.

In the second experiment, we treated induced seedlings by incorporating the 5% granular ethephon into the soil biweekly at a rate intended to maintain 75, 150, and 225 ppm in the soil (assuming ethephon was deactivated after 2 weeks). Treatments were commenced when the first flowering buds were visible. Stunting and phytotoxicity became apparent 10 days after the first treatment. The treatments were apparently not early enough to affect pollen sterility in the first flowers, as their pollen viability was not different than the untreated checks. However, after about 12 to 15 days, growth virtually ceased and flowers ceased to open, although the anthers appeared to be dehiscing inside the closed flowers. Practically no seed was formed on any treated plants.

Our experiments indicate that granular ethephon applied as a soil amendment was of no practical value as a gametocide on sugarbeet. If ethephon has any useful gametocide effect, it must occur in a very narrow range of concentration, and/or at a very specific stage of flower development. We plan one further experiment with granular soil incorporated ethephon to see if there is a narrow range of concentration and time in which it has some gametocidal effect.

Photosynthetic Efficiency in Relation to Performance

G. A. Smith and R. J. Hecker

Last year we reported the beginning of a laboratory technique for testing the photosynthetic efficiency of lines and crosses. The technique which has evolved, involves sampling 7.07 cm^2 leaf discs from eight plants from each line tested. These discs are taken in sets, with one set immediately oven dried and weighed and the other set subjected to 4 hours of high intensity mercury vapor light. After four hours, these discs are oven dried and weighed and the net increase in dry weight determined. Typical results using highly inbred lines and crosses between such lines are presented in Table 1. In 1974, these lines will be grown in the field in replicated tests and the results for sucrose %, recoverable sugar, etc., compared with the laboratory results.

Table 1. Preliminary results of leaf disc photosynthesis study showing weight gains after 4 hours of light treatment.

Inbred line or cross	Net[1] gain mgs/28.2 CM^2	% Increase
54-346	2.1	7.12
54-346 CMS X NB1	3.2	12.45
52-407	2.1	12.15
52-407 CMS X NB1	4.4	19.25
52-305 CMS X 52-407	2.7	9.72
52-407	3.3	12.98
52-407 CMS X 52-305	3.7	12.07
562	2.9	11.92
562 CMS X NB5	2.1	7.73
NB5	1.1	4.15
NB5 CMS X 54-346	2.5	9.09
52-430	3.9	15.23
52-305 CMS X 52-430	3.3	12.84
52-305	3.0	11.15
52-305 CMS X 52-307	3.5	15.28

[1]Net gain based on the mean of 8 replications of 4 leaf discs. Each leaf disc measuring 7.07 CM^2.

The results to date, such as those presented in Table 1, although interesting, may or may not be useful depending on the results of field trials of the same lines and crosses. Average percentage increases in dry weight have ranged from 4 to 20% in our initial tests.

A Preliminary Report on the Association of Purity and Nonsucrose Constituents of Sugarbeet

G. A. Smith, R. J. Hecker, and G. W. Maag

Recently we reported on the use of path coefficient analyses as a tool for describing the yield components for recoverable sugar (Smith and Hecker, Can. J. Plant Sci. 53:665-670). We are now using this approach to identify a model which best illustrates the relation of purity and nonsucrose constituents which directly affect purity. Path coefficient analysis simply defined is a method in which correlation coefficients (r's) are partitioned into direct and indirect effects. It provides a method of ranking as to order of importance a number of variables which are known to affect a dependent variable such as purity. We have designated purity as the dependent variable and Na, K, NO_3N, amino N, Cl, Total N, betaine, and total ash as the independent variables affecting purity. Figure 1 is one path diagram tested in our present studies. Any number of variables can be entered into the model as long as there is a cause and effect relation among the variables and the experimentor must assign direction in the causal system based upon a prior knowledge. Any and all combinations of variables can be tested. The best model is represented by a high coefficient of determination (R^2). The closer this figure approaches 100%, the better the model.

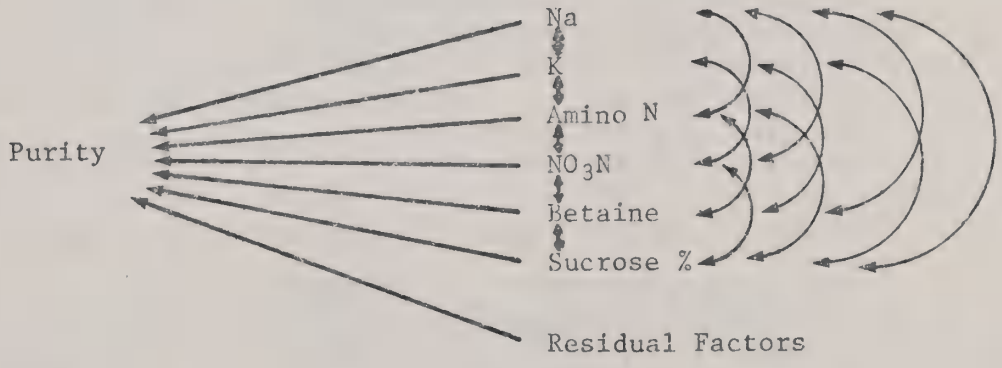

Figure 1. Path diagram illustrating the causal system of variables for purity in sugarbeet. In the path diagram the double-arrowed lines indicate mutual association as measured by correlation coefficients, and the single-arrowed lines represent direct influence as measured by path coefficients.

To date we have tested 28 genotypes for two years at two extreme N fertility levels. We have tested a random sample of commercial or near commercial varieties across a wide range of N fertility levels. In addition, we have sampled several juices, all in an attempt to find a universally best path model and/or determine the relative influence of genotype and environment on the rank and importance of the direct effects of the independent variables on purity.

Year and nitrogen fertility level were found to be major factors influencing the model which best describes purity. For example, data from 1970 at low N level produced a model with Na, K, NO_3N, amino N, betaine, and sucrose % as independent variables accounting for 67% of the variation in purity. At high N the same model accounted for 42% of the variation. The same model in 1972 accounted for only 5 and 29% at low and high N, respectively.

When data for the two nitrogen fertility levels was combined, the model with the same 6 characters described above accounted for 80% of the variation in purity for 1970, and 69% for 1972. Combining the data for the two N fertility levels caused a more normal frequency distribution curve and consequently the simple correlation coefficients which were used in the path coefficient analyses were all increased. This increase caused the coefficients of determination to be increased to the above recorded levels.

The usefulness of the path coefficient method (as compared to correlation analysis) can be illustrated by consideration of a particular case. The simple correlation between purity and betaine was low and negative (-.1172, Table 1). This value suggests that a decrease in betaine might result in a small increase in purity. A partition of this relationship into its components shows what factors contribute to the observed correlation. Path analysis, when the effects of sucrose, nitrate N, amino N, sodium, and potassium were held constant indicated that betaine was a factor influencing purity, the direct effect being -.2027. The indirect effects played an important part and partially masked the direct influence. Betaine via sucrose, nitrate N, sodium, and potassium had slight positive indirect effects on purity. The indirect effect of betaine via amino N (-.0382) was relatively small and negative. The net effect in this system of opposing influences was that the two negative effects outweighed the four positive effects and resulted in a small negative correlation between betaine and thin juice purity.

Table 1. Path coefficient analysis of betaine upon purity.

Purity versus betaine	
Direct effect	-.2027
Indirect effect via sucrose	.0584
Indirect effect via nitrate	.0495
Indirect effect via amino N	-.0382
Indirect effect via sodium	.0099
Indirect effect via potassium	.0059
Total correlation	-.1172

Of critical importance is the fact that, if total correlation were used to rank the importance of the measured characters as opposed to the direct effects quite different results were obtained. For example, ranking of the characters for the 1970 combined N level data by direct path effects and by total correlations (simple r's) is presented in Table 2. Also, the direct effects are useful in comparing the relative magnitude of the importance of the independent variables.

Table 2. Ranks of the independent variables effecting purity by direct effects and by simple correlation.

Independent variable	Correlation coefficient	Rank	Direct effect	Rank
Sucrose	.831	1	.339	2
Nitrate N	-.826	2	-.343	1
Amino N	-.762	5	-.254	3
Betaine	-.117	6	-.203	4
Sodium	-.776	4	-.064	5
Potassium	-.785	3	.042	6
Coefficient of determination, R^2 = 79.6				

Diploid Versus Tetraploid Resistance to *Cercospora* Leaf Spot

G. A. Smith

A preliminary experiment to surmise the possible differences in leaf spot resistance which may be accounted for by ploidy level was conducted in 1973. Diploid and tetraploid equivalents of known lines were grown under artifically induced leaf spot conditions in the field at Fort Collins in 1973.

Further crosses are intended to produce triploids of these same lines and these then will be tested along with the diploid and tetraploid equivalents.

The results of this preliminary test are presented in Table 1. Lines in the study are known to be only moderately to slightly resistant to *Cercospora* at the diploid level. The number of lines in this preliminary study was small and their range of leaf spot resistance narrow. The mean leaf spot readings from two reps at each of two dates is presented in the table. SP 5822-0 (entries 462 and 463) was the

only diploid tetraploid combination showing a potential dosage effect. At both leaf spot reading dates the tetraploid equivalent showed more resistance than did the diploid form.

Table 1. Mean leaf spot readings for several diploid and tetraploid equivalent sugarbeet lines grown under field leaf spot conditions at Fort Collins.

Seed no.	Entry no.	Description	Mean leaf spot readings 9-6-73	9-17-73
721098A	462	Tetraploid SP 5822-0	3.0	2.5
A63-5	463	Diploid SP 5822-0	5.0	6.7
721097HO	464	Tetraploid 52-305	5.7	6.7
70-9113	465	Diploid 52-305	4.2	5.0
A64-3	466	Tetraploid SP 5481-0	4.7	5.2
A64-2	467	Diploid SP 5481-0	4.2	5.0
A73-2	468	Tetraploid (SP 68B10-00) 02 clone	4.2	5.5
A73-1	469	Diploid (67P21) 02 clone	3.7	4.5
Acc. 1382	470	SP 5481-0	4.2	4.7

Development and Evaluation of Sugarbeet Breeding Material with Resistance to Leaf Spot and or Curly Top, 1973

G. A. Smith, E. G. Ruppel, and Cooperators

A very satisfactory leaf spot epidemic developed in our Fort Collins leaf spot nursery in 1973. Field work under these conditions included a cooperative test of LSR-CTR varieties; observational tests of submitted sugar company lines; observational tests of Great Western growers joint committee test; experimental lines, basic genetic studies and selection in various crosses.

Of special concern this year, was the development of curly top in the leaf spot nursery and in the steckling production field. Apparently, the inoculation took place very late in the season as very few plants showed symptoms at harvest. The fact that infection was more severe is now being seen in the regrowth of the stecklings in the greenhouse.

Selection in *Beta maritima* X *Beta vulgaris* back cross populations produced some excellent sugarbeet types with high leaf spot resistance. Further crosses with high sucrose selection from *Beta vulgaris* are planned.

The varieties described in Table 1 were evaluated by federal, state, and sugar company research personnel in several states in 1972.

The entries were tested at Fort Collins under leaf spot conditions, Rhizoctonia, and under disease free conditions. Also, entries were evaluated for curly top resistance at Logan, Utah, and were also read for curly top at Hereford, Texas (by Holly Sugar Company personnel). Again this year the entries were grown in the San Juan Basin area near Farmington, New Mexico to evaluate both the material and the area.

Table 1. Description of material in cooperative evaluation tests of LSR-CTR varieties, 1973.

Entry no.	Seed no.	Variety description
1	SP 711209H09	[FC(504 x 502/2) x SP 652016s1 x SP 662048s1] x FC 703
2	SP 711208H09	[FC(504 x 502/2) x SP 652016s1 x SP 662048s1] x McF 413
3	SP 711203H017	(FC 506 x SP 662119s1) x FC 902
4	SP 711208H02	FC 506 x McF 413
5	SP 711151HO	F_4, SP 632028s1 x FC 601
6	SP 701208H05	(632028s1 x subline FC 601) x FC 702/2
7	Acc. 2771	US H9B; CTR check
8	SP 701201H03	FC(504 x 502/2) x SP 6322-0
9-12		Local checks furnished by cooperator

The disease ratings for leaf spot and curly top and Rhizoctonia are summarized in Table 2. The epidemic of leaf spot at Fort Collins was severe and reliability of the tests was considered excellent. The standard procedure for curly top evaluation at Logan is to convert actual readings to percent of US 41. Entry number 2 showed evidence of considerable resistance to both leaf spot and curly top. For Rhizoctonia, % healthy are those plants which are healthy at the end of the season or plants which have arrested lesions.

Table 2. Leaf spot and curly top results for 1973 Cooperative Agronomic Test of LSR-CTR varieties.

Entry no.	Seed number	Beltsville leaf spot (8/24/73)	Ft.Collins leaf spot (9/17/73)	Logan,Utah curly top (% of US 41)	Ft.Collins Rhizoctonia (% healthy)
1	SP 711209H09	3.17	3.58	105.8	52.5
2	SP 711208H09	3.00	3.33	86.5	21.2
3	SP 711203H017	3.67	3.25	96.2	28.4
4	SP 711208H02	4.00	3.42	105.8	24.3
5	SP 711151HO	3.00	3.17	96.2	33.1
6	SP 701208H05	3.33	4.58	96.2	46.1
7	Acc. 2771	5.75	4.58	86.5	29.6
8 LSR ck	SP 701201H03	3.25	3.25	134.6	28.8
9 Local ck	A72-7(GW Mono Hi A-1)	3.08	5.58		
Rhizoc ck	FC 701/5				71.4
CTR ck	US 41			100.0	

Tables 3 thru 11 present the results of the individual tests as conducted at Fort Collins and at 8 other locations.

Table 3. Cooperative Agronomic Test of LSR-CTR Varieties, 1973
Location: Fort Collins, Colorado (Exp. 3) disease free

Seed no. or variety	Entry no.	Acre yield				Sucrose		Purity
		Gross sucrose		Beets				
		Lbs.	% check	Tons	% check	%	% check	%
SP 711209HO9	1	5877	111	16.36	105	17.96	105	95.23
SP 711208HO9	2	6030	114	17.60	113	17.13	101	97.03
SP 711203HO17	3	5488	103	16.17	104	16.97	100	97.48
SP 711208HO2	4	6186	117	17.89	115	17.29	101	96.33
SP 711151HO	5	1836	35	5.47	35	16.78	98	96.67
SP 701208HO5	6	5813	110	15.90	102	18.28	107	96.48
Acc. 2771	7	5763	109	16.84	108	17.11	100	96.67
SP 701201HO3(check)	8	5303	100	15.56	100	17.04	100	97.65
A72-7	9	6475	122	17.77	114	18.22	107	96.17
General mean		5419		15.51		17.42		96.64
C. V. %		--		11.4		3.42		1.45
LSD (.05)		--		1.5	10	.70	4	1.63

Conducted by: G. A. Smith

Dates of Planting and Harvest: May 10; October 12

Experimental Design (Including no. of reps): Randomized complete block with six replications, 2 row plots. Plot length 20 feet.

Determination of Beet Yield and Sucrose Percentage: Standard methods.

Leaf Spot Exposure: Negligible

Curly Top Exposure: Very late exposure, beets affected very little.

Other Diseases and Pests: None

Reliability of Tests and Remarks: Very good

Table 4. Cooperative Agronomic Test of LSR-CTR Varieties, 1973
Location: Longmont, Colorado

Seed no. or variety	Entry no.	Acre yield				Sucrose		Plants per 100'
		Gross sucrose		Beets				
		Lbs.	% check	Tons	% check	%	% check	No.
SP 711209HO9	1	8923	117	26.4	111	16.9	106	111
SP 711208HO9	2	7831	103	25.1	105	15.6	98	125
SP 711203HO17	3	8311	109	26.3	111	15.8	99	115
SP 711208HO2	4	7862	103	25.2	106	15.6	98	107
SP 711151HO	5	4435	58	14.4	61	15.4	96	95
SP 701208HO5	6	7326	96	22.2	93	16.5	103	116
Acc. 2771	7	8347	110	27.1	114	15.4	96	115
SP 701201HO3(check)	8	7616	100	23.8	100	16.0	100	117
MONO HY D2(Loc.ck)	9	9263	122	27.9	117	16.6	104	119
General mean		7776		24.3		16.0		113
C.V. (%)		9.9		10.0		3.5		
LSD (.05)		727	10	2.8	12	.7	4	

Conducted by: Great Western Sugar Company.

Dates of Planting and Harvest: Planted 4/24/73; Harvested 10/16/73.

Experimental Design (Including no. of reps): 3 x 3 Triple Lattice, 4 row plots, 6 replications.

Determination of Beet Yield and Sucrose Percentage: All beets were harvested in competitive stand area, 18 ft. of row, where possible. Little trimming was done.

Leaf Spot Exposure: None.

Curly Top Exposure: Very slight, if any.

Other Diseases and Pests: Field was fumigated for nematodes and treated for sugarbeet root maggot.

Reliability of Test and Remarks: Good Test - The planting date was a little later than desired.

Table 5. Cooperative Agronomic Test of LSR-CTR Varieties, 1973
Location: Hereford, Texas

Seed no. or variety	Entry no.	Acre yield				Sucrose		Plants per 100'	Curly top grade
		Gross sucrose		Beets					
		Lbs.	% check	Tons	% check	%	% check	No.	
SP 711209HO9	1	7505	120	28.5	110	13.18	109	151	6.6
SP 711208HO9	2	7358	118	28.1	108	13.08	108	153	5.1
SP 711203HO17	3	7952	127	31.6	122	12.57	104	163	5.8
SP 711208HO2	4	8293	133	32.3	125	12.86	106	149	5.8
SP 711151HO	5	3379	54	11.2	43	15.09	125	136	5.7
SP 701208HO5	6	7552	121	27.0	104	14.01	116	153	6.0
Acc. 2771	7	7580	121	31.4	121	12.03	100	156	4.4
SP 701201HO3(Check)	8	6246	100	25.9	100	12.08	100	132	6.9
General mean		7140		27.8		12.98		149	5.9
CV (%)		11		10		3.99			
LSD		728	12	2.6	10	0.49	4		

Conducted by: Holly Sugar Corporation.

Dates of Planting and Harvest: Planted 4/30/73; Harvested 11/01/73.

Experimental Design (Including No. of Reps): Randomized complete block, 9 replications.

Determination of Beet Yield and Sucrose Percentage: Standard methods.

Leaf Spot Exposure: None

Curly Top Exposure: Data from curly top nursery appears reliable.

Other Diseases and Pests: None.

Reliability of Test and Remarks: The test in general was good, and data is reliable within the statistical limits. Good field conditions.

Table 6. Cooperative Agronomic Test of LSR-CTR Varieties, 1973
Location: Farmington, New Mexico

Seed no. or variety	Entry no.	Acre yield				Sucrose		Purity
		Gross sucrose		Beets				
		Lbs.	% check	Tons	% check	%	% check	%
SP 711209HO9	1	5496	125	12.1	119	19.85	100	94.48
SP 711208HO9	2	5772	131	14.7	144	18.88	95	96.63
SP 711203HO17	3	6432	146	15.3	150	19.90	100	97.68
SP 711208HO2	4	6999	159	15.4	151	19.63	99	96.73
SP 711151HO	5	2686	61	6.0	59	18.98	95	96.33
SP 701208HO5	6	5961	136	14.2	139	20.35	103	96.58
Acc. 2771	7	6933	158	15.4	151	20.38	103	96.50
SP 701201HO3 (check)	8	4392	100	10.2	100	19.85	100	97.00
Am.Crystal 4 Hy A	9	4632	105	9.7	95	21.43	108	97.53
Holly Sugar HH-7	10	5968	136	13.7	134	19.95	101	96.50
General mean		5525		12.7		19.92		96.59
CV (%)		13.8		14.7		3.4		1.4
LSD (.05)		1114	25	2.2	22	.98	5	.63

Conducted by: E. J. Gregory.

Dates of Planting and Harvest: Planted April 26; Harvested November 11.

Experimental Design(Including No. of Reps): Randomized block, 6 replications.

Determination of Beet Yield and Sucrose Percentage: Standard methods.

Leaf Spot Exposure: None.

Curly Top Exposure: Very mild.

Other Diseases and Pests: Beet yellows or Western yellows.

Reliability of Test: Poor.

Table 7. Cooperative Agronomic Test of LSR-CTR varieties, 1973
Location: Two Buttes, Colorado

Seed no. or variety	Entry no.	Acre yield: Gross sucrose		Acre yield: Beets		Sucrose		Recov. sugar/ acre
		Lbs.	% check	Tons	% check	%	% check	
SP 711209H09	1	4874	97	16.80	97	14.50	100	4352
SP 711208H09	2	4857	97	17.93	103	13.54	94	4262
SP 711203H017	3	4952	99	17.52	101	14.17	98	4416
SP 711208H02	4	4887	97	17.56	101	13.91	96	4313
SP 711151H0	5	1219	24	4.14	24	14.75	102	1089
SP 701208H05	6	4639	92	15.68	90	14.77	102	4194
Acc. 2771 (US H9B)	7	5280	105	19.05	110	13.84	96	4652
SP 701201H03 (check)	8	5022	100	17.35	100	14.43	100	4493
Am #2 Hybrid "B"	9	5555	111	19.37	112	14.36	96	4924
Am #2 Hybrid "C"	10	5042	100	17.66	102	14.29	99	4508
SL(129X133)msXFC701/2	11	5061	101	17.30	100	14.62	101	4531
SL(129X133)ms X FC703	12	5098	102	16.90	97	15.07	104	4563
General mean		4707		16.44		14.35		4192
CV (%)		11.97		11.16		4.21		12.22
LSD (.05)		653	13	2.13	12	.70	5	594

Conducted by: American Crystal Sugar Company Research Personnel.

Dates of Planting and Harvest: Planted mid April; Harvested mid October.

Experimental Design (Including No. of Reps): 12 X 6 Equal Random; 6 reps.

Determination of Beet Yield and Sucrose Percentage: Standard procedure.

Leaf Spot Exposure: Negligible.

Curly Top Exposure: Negligible.

Other Diseases and Pests: Negligible.

Reliability of Test and Remarks: Very satisfactory.

Table 8. Cooperative Agronomic Test of LSR-CTR Varieties, 1973
Location: Rocky Ford, Colorado

Seed no. or variety	Entry no.	Acre yield				Sucrose		Recov. sugar/ acre
		Gross sucrose		Beets				
		Lbs.	% check	Tons	% check	%	% check	
SP 711209HO9	1	6834	114	24.14	101	14.16	112	5688
SP 711208HO9	2	6291	105	23.66	99	13.30	105	5105
SP 711203HO17	3	6762	113	25.63	107	13.30	105	5513
SP 711208HO2	4	6044	101	24.14	101	12.59	100	4840
SP 711151HO	5	2677	45	9.42	39	14.11	112	2249
SP 701208HO5	6	7110	119	24.83	104	14.39	114	6075
Acc. 2771 (US H9B)	7	6118	102	24.59	103	12.50	99	4837
SP 701201HO3 (check)	8	5999	100	23.95	100	12.64	100	4826
Am #2 Hybrid "B"	9	6886	115	27.62	115	12.57	99	5574
Am #2 Hybrid "C"	10	5674	95	22.46	94	12.73	101	4581
SL(129X133)msXFC701/2	11	6804	113	26.40	110	13.04	103	5510
SL(129X133)msX FC 703	12	6639	111	25.62	107	13.06	103	5362
General mean		6153		23.54		13.20		5013
CV (%)		13.0		11.09		5.86		14.06
LSD (.05)		928	15	3.03	13	.90	7	818

Conducted by: American Crystal Sugar Company Research Personnel.

Dates of Planting and Harvest: Planted mid April; Harvested mid October.

Experimental Design (Including No. of Reps): 12 X 6 Equal Random, 6 reps.

Determination of Beet Yield and Sucrose Percentage: Standard procedure.

Leaf Spot Exposure: Negligible.

Curly Top Exposure: Negligible.

Other Diseases and Pests: Negligible.

Reliability of Test and Remarks: Very satisfactory.

Table 9. Cooperative Agronomic Test of LSR-CTR Varieties, 1973
Location: Ulysses, Kansas

Seed no. or variety	Entry no.	Acre yield				Sucrose		Recov. sugar/ acre
		Gross sucrose		Beets				
		Lbs.	% check	Tons	% check	%	% check	
SP 711209HO9	1	5776	112	22.27	104	12.97	108	4938
SP 711208HO9	2	4765	92	20.78	97	11.47	95	3996
SP 711?03HO17	3	5040	98	20.99	98	12.06	100	4318
SP 711208HO2	4	5000	97	21.65	101	11.55	96	4214
SP 711151HO	5	1190	23	4.82	23	12.23	101	1039
SP 701208HO5	6	5027	97	20.16	94	12.38	103	4353
Acc. 2771 (US H9B)	7	5236	101	22.97	107	11.38	94	4381
SP 701201HO3(check)	8	5168	100	21.39	100	12.06	100	4449
Am #2 Hybrid "B"	9	6144	119	25.49	119	12.04	100	5230
Am #2 Hybrid "C"	10	4958	96	21.28	99	11.66	97	4204
SL(129X133)msXFC701/2	11	5936	115	24.13	113	12.30	102	4996
SL(129X133)msX FC 703	12	5663	110	22.77	106	12.47	103	4858
General mean		4992		20.73		12.05		4248
CV (%)		13		10.97		6.53		14
LSD (.05)		756	15	2.64	12	.91	8	688

Conducted by: American Crystal Sugar Company Research Personnel.

Dates of Planting and Harvest: Planted mid April; Harvested mid October.

Experimental Design (Including No. of Reps): 12 X 6 Equal Random, 6 reps.

Determination of Beet Yield and Sucrose Percentage: Standard procedure.

Leaf Spot Exposure: Negligible.

Curly Top Exposure: Negligible.

Other Diseases and Pests: Negligible.

Reliability of Test and Remarks: Very satisfactory.

Table 10. Cooperative Agronomic Test of LSR-CTR Varieties, 1973
Location: East Grand Forks, Minnesota

Seed no. or variety	Entry no.	Acre yield				Sucrose		Recov. sugar/ acre
		Gross sucrose		Beets				
		Lbs.	% check	Tons	% check	%	% check	
SP 711209HO9	1	5116	89	18.81	89	13.61	100	4438
SP 711208HO9	2	5822	101	21.58	102	13.50	99	5047
SP 711203HO17	3	5695	99	21.12	100	13.48	99	4996
SP 711208HO2	4	6350	110	23.58	111	13.47	99	5472
SP 711151HO	5	2198	38	7.97	38	13.77	101	1943
SP 701208HO5	6	5353	93	19.24	91	13.92	103	4739
Acc. 2771 (US H9B)	7	5933	103	22.63	107	13.13	97	5058
SP 701201HO3 (check)	8	5761	100	21.19	100	13.58	100	5016
Am #2 Hybrid "B"	9	6265	109	23.10	109	13.56	100	5444
Am #2 Hybrid "C"	10	5753	100	20.89	99	13.77	101	5040
SL(129X133)msXFC 701/2	11	6119	106	22.42	106	13.65	101	5255
SL(129X133)msX FC 703	12	5861	102	21.18	100	13.84	102	5064
General mean		5519		20.31		13.61		4793
CV (%)		7		6.62		2.39		7
LSD (.05)		421	7	1.56	7	.38	3	371

Conducted by: American Crystal Sugar Company Research Personnel.

Dates of Planting and Harvest: Planted mid April; Harvested mid October.

Experimental Design (Including No. of Reps): 12 X 6 Equal Random, 6 reps.

Determination of Beet Yield and Sucrose Percentage: Standard procedure.

Leaf Spot Exposure: Negligible.

Curly Top Exposure: Negligible.

Other Diseases and Pests: Negligible.

Reliability of Test and Remarks: Very satisfactory.

Table 11. Cooperative Agronomic Test of LSR-CTR Varieties, 1973
Location: Garden City, Kansas

Seed no. or variety	Entry no.	Acre yield				Sucrose		Recov. sugar/ acre
		Gross sucrose		Beets				
		Lbs.	% check	Tons	% check	%	% check	
SP 711209HO9	1	6151	96	20.28	95	15.18	101	5361
SP 711208HO9	2	5764	105	20.21	94	14.29	95	5002
SP 711208HO17	3	5912	92	20.72	97	14.31	95	5130
SP 711208HO2	4	6368	99	21.52	101	14.78	98	5520
SP 711151HO	5	1719	27	5.80	27	14.84	99	1505
SP 701208HO5	6	6368	99	20.16	94	15.84	106	5636
Acc. 2771 (US H9B)	7	5952	93	21.55	101	13.78	92	5082
SP 701201HO3 (check)	8	6421	100	21.39	100	15.01	100	5662
Am #2 Hybrid "B"	9	6933	108	23.65	111	14.69	98	6081
Am #2 Hybrid "C"	10	5836	91	19.74	92	14.80	99	5162
SL(129X133)msXFC 701/2	11	6315	98	21.39	100	14.80	99	5472
SL(129X133)msX FC 703	12	7045	110	22.80	107	15.45	103	6206
General mean		5899		19.93		14.81		5152
CV (%)		10		9.90		4.22		10
LSD (.05)		661	10	2.29	11	.72	5	589

Conducted by: American Crystal Sugar Company Research Personnel.

Dates of Planting and Harvest: Planted mid April; Harvested mid October.

Experimental Design (Including No. of Reps): 12 X 6 Equal Random, 6 reps.

Determination of Beet Yield and Sucrose Percentage: Standard procedure.

Leaf Spot Exposure: Negligible.

Curly Top Exposure: Negligible.

Other Diseases and Pests: Negligible.

Reliability of Test and Remarks: Very satisfactory.

SUGARBEET RESEARCH

1973 Report

Section D

North Dakota Agricultural Experiment Station, Fargo, North Dakota

Dr. W. M. Bugbee, Plant Pathologist
Dr. D. F. Cole, Plant Physiologist

Cooperation:

American Crystal Sugar Company
Minnesota Agricultural Experiment Station
North Dakota Agricultural Experiment Station
Red River Valley Sugarbeet Growers Association, Inc.

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CONTENTS

SUGAR BEET DISEASE RESEARCH - FARGO
W. M. Bugbee

Prevalence of Phoma betae in soil

A selective medium was developed for the enumeration and isolation of Phoma betae from soil and seed and consisted of: 4 g K_2HPO_4; 1.5 g KH_2PO_4; 25 ml soil extract; 200 mg boric acid; 100 mg each of streptomycin sulfate, chlorotetracycline, and benomyl; 10 g sucrose; and 17 g agar in 1000 ml distilled water, adjusted to pH 7.0 with HCl before autoclaving. Sucrose and the antibiotics were added to the molten agar after autoclaving. Phoma betae was characterized by the production of small, dark hyphal masses resembling microsclerotia on the underside of the culture in contact with the petri plate.

Populations of P. betae were estimated by counting colonies on soil dilution plates. Soil samples were air dried then screened through a 2 mm soil sieve. Ten gm soil samples were shaken in 100 ml of sterile distilled water for 15 min. One ml aliquots were taken from soil suspensions agitated by a magnetic stirrer and dispensed to each of ten sterile petri plates. Ten-15 ml of a molten (50 C) selective agar medium were poured into the plates. The cultures were incubated at 22 C for 2 weeks when colonies were counted.

Roots of crop and weed plants were plated on the selective medium. Wheat, barley, oats, and rye were planted in a plot that had been in continuous sugar beets for the previous 5 years. After harvest, 25 randomly selected plants of each crop were lifted from the soil. The roots were washed, cut into 1-2 cm pieces and bulked. The root pieces were treated with 2% sodium hypochlorite for 2 min followed by two rinses in sterile distilled water. Ten root pieces were plated on each of five plates. A similar procedure was followed for weed root systems that were collected from storage sites and sugar beet plot areas.

Soil samples were taken in July from the rotation plots of O. Soine, Soil Scientist, located at the University of Minnesota Agricultural Experiment Station, Crookston. This was the seventh year of the second cycle of a 4-year rotation. Soil was collected from 4-8 locations in each plot and bulked. Total weight of the sample from each replicate was .9-1.4 kg.

Populations of P. betae at storage sites.-The soil at a storage pile site at Moorhead, Minnesota was sampled in May, June, and September and showed a population of P. betae of 185, 570, and 13 propagules/g soil respectively. Additional locations were sampled in June and September. The concentra-

tion of P. betae ranged from 88 to 512 propagules/g soil in June compared to 0 to 13 propagules/g soil in September. P. betae was absent in one of the seven sites sampled in September (Table 1).

Population of P. betae in soil from rotation and continuous sugar beet plots.-Analysis of soil samples from a plot that had been cropped to sugar beets for five consecutive years showed a population in April, May, June, July, and August of 380, 62, 64, 5, and 1 propagules/g soil respectively.

Phoma betae was present in soil of the first and second but never the third crop after sugar beets. Phoma was not found in any of the soils of rotation number five, which included soybeans. The highest populations of P. betae occurred the year after sugar beets in soil planted to wheat in rotations two and six (Table 2). Rotation number three was the only one where P. betae was present in soil the same year in which sugar beets were planted.

The presence of P. betae in soil sampled in July of the second crop after sugar beets showed that this fungus survived 26 months after the sugar beets were planted.

P. betae in roots of crop and weed hosts.-The number of root pieces of wheat, barley, oats, and rye plated out were 405, 336, 355, and 322 respectively. P. betae was recovered from only one root piece from oats. Sweetclover and potato debris were collected from the rotation plots after harvest and plated out. P. betae was not recovered from this material, even though the fungus was present in the soil of the potato plot.

Fourteen weed species were collected from five storage sites in June 1973. P. betae was present in the roots of only lambsquarter, (Chenopodium album L.). The prevalence ranged from seven of 15 plants infected from the Cummings, North Dakota site to all of the nine plants being infected from the East Grand Forks, Minnesota site. Another collection of lambsquarter was made in September. This time the root pieces from all plants from a particular site were bulked. Only plants collected at the Comstock and Hendrum, Minnesota sites had roots infected with P. betae (Table 1).

A collection of lambsquarter also was made in May from the plot that had been in sugar beets for 5 years. A total of 20 plants of 38 collected were infected.

Twenty lambsquarter plants were randomly collected from a weed control plot at Casselton, North Dakota. Three of these were infected with P. betae but the fungus was not

Table 1. The population of Phoma betae in the soil at seven sugar beet storage locations in June and September and the prevalence of infected roots of lambsquarter growing at these sites in September.

Site	Propagules/g soil		Lambsquarter roots[a]	
	June	September	No. plated	No. infected
Moorhead	512	13	50	0
East Grand Forks	171	4	20	0
Crookston	148	2	20	0
Comstock	---	16	50	8
Hendrum	288	4	50	5
Warren	---	0	20	0
Cummings	88	1	20	0

[a] Lambsquarter plants were collected at random, the roots were cut in 1-2 cm pieces and bulked before plating.

Table 2. The population of Phoma betae in soils of six different crop rotations used in the Red River Valley of North Dakota and Minnesota.

Rotations	Propagules/ gm	Rotations	Propagules/ gm
1.		2.	
Sugar beets	0[a]	Sugar beets	0
Wheat	0	Wheat	20
Barley	2	Barley	0
Black fallow	0	Sweetclover fallow	0
3.		4.	
Sugar beets	2	Sugar beets	0
Wheat	5	Potato	2
Barley	0	Wheat	6
Alfalfa fallow	0	Barley	0
5.		6.	
Sugar beets	0	Sugar beets	0
Wheat	0	Wheat	19
Barley	0	Barley	4
Soybeans	0	Oats	0

[a] Average of three replications.

found in soil samples taken from the same location.

DISCUSSION.-Sugar beet storage yards contain many roots and root pieces embedded in the soil after the pile has been removed and processed. These roots provide ideal organic material for the survival of P. betae, thus the very high concentration of P. betae in early summer before the roots have been decomposed. Phoma is still viable in the soil in September when storage of the new crop begins. It is not known how much this source of inoculum contributes towards storage rot.

Analysis of soils from rotation plots indicate that P. betae will survive in soil up to 26 months after sugar beets have been planted. These rotations included crops and fallow practices commonly used in the Red River Valley. High populations of P. betae occurred occasionally in soil the year after sugar beets and early in the summer in storage yards. This probably was due to the build-up of the fungus on sugar beet debris.

Lambsquarter is a very common weed in sugar beet fields and in storage yards. The ability of P. betae to inhabit the roots of this weed might enable the fungus to survive a four year rotation. This weed should not be important in storage yards where sugar beet debris is plentiful and sites of storage are not rotated.

Wheat, barley, rye, potato, and sweetclover were not hosts of P. betae, but the fungus was able to inhabit the roots of oats. The frequency of invasion was so low that it might be considered insignificant.

P. betae is seed borne and will survive in sugar beet plants that do not damp-off. This is a source of inoculum for storage rot. Currently it is very difficult to eradicate P. betae from seed with cleared fungicides. Therefore, the cultural practices of four year rotations and control of lambsquarter assumes greater importance.

Rhizoctonia foliar blight

Rhizoctonia foliar blight has been known for many years but not considered economically important. This disease is widespread in the valley with some fields having 80% of the plants affected. Leaf blades in the center of the rosette become black at the margins and distorted in shape. Entire blades become black leaving only the black stubs of petioles in severe cases. Plants never die and extensive regrowth is not evident. Nevertheless, this disease was investigated to

determine its effect on certain quality and decay characteristics during storage.

A random sample of 100 plants with symptoms and 100 plants without symptoms were collected from a plot of American 3 hybrid T at the North Dakota Agricultural Experiment Station, Fargo. The samples of diseased or healthy plants were divided into 10 groups of 10 roots per group. Each root was split in half longitudinally. Brei samples were made from one half and the other half was placed in storage at 4-6°C for 80 days. Two cores were removed from each half-root and a brei sample was taken after storage. Resistance to Phoma betae was measured by placing the cores on an agar culture of the fungus. The amount of decay was measured 2 weeks later.

RESULTS.-Sucrose contents were low and impurities were high because a low stand count resulted in large roots and there was excessive rain at harvest. But there was still a statistically significant difference in sucrose, sodium, potassium, and total amino acids content of roots with foliar symptoms compared to roots without (Table 3). Roots from plants with symptoms had lower sucrose and higher sodium contents than healthy plants. This was also true after storage. Diseased plants had a higher amino acid content but only after storage. The potassium content was higher in diseased plants at harvest but not after storage. There was no apparent effect of foliar rhizoctonia on the invert sugar level.

The storage decay results have not been analyzed. But the results so far suggest that foliar rhizoctonia may be economically important in fields with high prevalence. Further tests are needed to determine how prevalent the disease must be before a loss will occur. Chemical control measures by foliar applications of fungicides used against cercospora leaf spot proved unsatisfactory in a test last summer.

Table 3. The effect of rhizoctonia foliar blight on certain quality characteristics at harvest and after storage.

Storage	Rhizoctonia	Sucrose	Na	K	Total Amino Acids	Invert
Days		%	ppm	ppm	ppm	mg/ml
0	Yes	9.3	1557	2621	2265	1.51
	No	10.0	1353	1605	1714	1.37
80	Yes	8.6	1554	2243	3224	4.04
	No	9.2	1334	2469	2057	3.51
LSD, .05		0.4	85	231	568	.68

ABSTRACT OF PAPER APPROVED FOR PUBLICATION

BUGBEE, W. M. A selective medium for the enumeration and isolation of Phoma betae from soil and seed. Phytopathology (In press).

A nutrient medium was developed to selectively culture Phoma betae from soil and seed. This will facilitate investigations of the effect of agricultural practices on the dispersal and survival of this important pathogen of sugar beets.

SUGARBEET PHYSIOLOGY

Dr. Darrell F. Cole

Sugarbeet storage is one of the major problems confronting the sugarbeet industry in the Red River Valley area. With the increase in acreage (3 new Cooperatives) the number of beets in storage will increase dramatically next year. This increase along with the present production will probably cause an estimated loss of $30-35 million during the storage period in the Red River Valley. Several factors affect the loss of sugar during storage including temperature, humidity, variety, and microbial degradation. The temperature of the beets is probably the most important factor affecting the loss of sugar. As temperature is increased 10 F, respiration rates are doubled. Higher temperatures also increase the losses due to microbial degradation. Temperature control of the stored beets appears to be an area where large scale tests need to be conducted. Unless temperatures are controlled other factors affecting storeability of beets may be difficult to assess.

Presently we are investigating several factors which may affect storeability of beets under controlled temperature conditions. These factors include genetic, cultural and other agronomic practices. Specifically we are looking at variety, fertility, herbicides, moisture, and mechanical damage effects on beets stored at 5 C.

Data in Table 1 shows differences among six varieties in yield, sucrose and impurity levels at harvest. These varieties are being studied through a 150 day storage period by measuring respiration rates and other physiological changes.

Fertility effects (high nitrogen) are shown on two varieties (Table 2). The residual nitrogen level (150 lb/A at planting) appeared to be adequate for maximum yields since no significant differences were detected at harvest. However, the high N level caused a significant reduction in the amount of extractable sugar due to high levels of impurities and lower sucrose levels.

TABLE 1

VARIETY TEST, FARGO, N.D. 1973

Variety	Yield T/A	Sucrose %	Gross Sugar T/A	Impurity index	Extractable Sugar %	Net Sugar T/A	Invert Sugar PPM	Amino acids PPM	Potassium PPM	Sodium PPM
Mon-Hy D-2	29.9	12.6	3.7	974	8.5	2.5	782	2881	2840	621
Am 2-B	28.4	12.3	3.4	1111	7.7	2.2	1248	3910	2566	943
Bush-Mono	27.2	11.3	3.0	1300	6.3	1.7	1495	3636	2758	1188
B-93	22.2	12.9	2.8	1087	8.2	1.8	1098	4047	2675	918
Am-4A	19.9	12.0	2.4	1246	6.9	1.4	1633	4870	2477	1090
Am-4T	18.3	13.5	2.4	857	9.7	1.8	1557	3361	2531	510
Mean	24.1	12.4	3.0	1096	7.9	1.9	1302	3784	2641	878
LSD (1% Level)	4.5	0.7	0.6	148	1.1		292	819	272	164
C.V. (%)	15.6	4.5	15.7	11.2	11.2		18.6	18.0	8.6	15.4
"F"	16.8**	18.1**	14.1**	18.0**	18.7**		17.9**	9.8**	3.9**	37.7**

* Significance 1% level.

TABLE 2

VARIETY X NITROGEN TEST, FARGO, N.D. 1973

	Parameter										
Variable	Yield T/A	Sucrose %	Invert Sugar PPM	Potassium PPM	Sodium PPM	Amino acids PPM	Gross Sugar T/A	Impurity index	Extractable Sugar %	Net Sugar T/A	Loss %
Nitrogen											
+ 300 lb/A	20.8	11.3	1615	2444	1339	5431	2.35	1439	5.6	1.15	50.4
Residual	20.6	12.8	1724	2146	1246	4716	2.64	1137	8.0	1.63	38.3
"F"	0.1	45.8**	1.4	4.8	1.6	10.2*	12.4*	19.1**	27.0**	19.3**	20.2**
C.V. (%)	6.7	4.5	13.3	13.6	13.8	10.8	8.3	13.1	16.2	18.9	14.8
Variety											
Bush-Mono	23.0	11.8	1452	2461	1366	5545	2.70	1411	6.0	1.38	49.3
Am-4A	18.5	12.4	1887	2146	1220	4601	2.29	1164	7.6	1.40	39.4
"F"	47.1**	6.7*	24.9**	22.7**	5.8*	7.95*	16.7**	25.9**	18.0**	0.1	27.2**
C.V. (%)	7.8	7.2	12.7	7.0	11.4	16.2	9.8	9.2	13.2	17.3	10.5

* Significance 5% level.

** Significance 1% level.

SUGARBEET RESEARCH

1973 Report

Section E

Michigan Agricultural Experiment Station, East Lansing, Michigan

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Dr. C. L. Schneider, Plant Pathologist
Dr. F. W. Snyder, Plant Physiologist
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Cooperation:

Farmers and Manufacturers Beet Sugar Association
American Crystal Sugar Company
Holly Sugar Corporation
Buckeye Sugars, Inc.
Michigan Sugar Company
Monitor Sugar Division
Northern Ohio Sugar Company
Michigan Agricultural Experiment Station

The research was supported in part by funds provided through the Beet Sugar Development Foundation (Projects 20 and 26).

CONTENTS

EVALUATION OF SUGARBEET HYBRIDS

Prepared by C. J. Hogaboam

The evaluation program in 1973 was again cooperative with the Farmers and Manufacturers Beet Sugar Association and its member companies. Hybrid seeds were also supplied to The Great Western Sugar Company, The Holly Sugar Corporation and The American Crystal Sugar Company for their testing and evaluation. Emergence problems forced us to abandon three of our four area evaluation tests planted in Michigan and Ohio. The Great Western tests planted in Northern Ohio were also abandoned for the same reason. Included are two tests by The Holly Sugar Corporation at Torrington, Wyoming. Also included are 10 tests by The American Crystal Sugar Corporation at Rocky Ford, Colorado and East Grand Forks, Minnesota, conducted in 1973, as well as six tests of USDA and other hybrids, which were conducted at these same locations in 1972.

The percent sucrose, percent clear juice purity, and recoverable white sugar per ton were determined according to "A rapid and practical method of determining extractable white sugar as may be applied to the evaluation of agronomic practices and grower deliveries in the sugarbeet industry", by S. T. Dexter, M. G. Frakes and F. W. Snyder, as published in the Journal of the American Society of Sugar Beet Technologists, Vol. 14, No. 5.

When data from the five Michigan tests were combined, US H20 as entry 3, was significantly better than all other hybrids tested in recoverable white sugar per acre (RWSA). This also held true for yield of roots in tons/acre (T/A). Entries 5 and 6 were significantly below US H20, but significantly above the rest of the hybrids in RWSA and T/A. Entries 2 (US H21) and 4 were significantly better than all others in quality as measured by recoverable white sugar per ton (RWST). US401 as entry 1 was significantly below all others in RWST. In the Ohio 6 x 6 test, the quality of US H21 was enough to compensate for its slightly lower yield to where it gave the highest RWSA. Some of this performance may be ascribed to its superior leaf spot resistance. It is interesting to compare US401 (entry 1), the commercial variety grown in the 1950's, with entry 3, the commercial variety grown at present. The present commercial is 21% higher in recoverable white sugar per acre than the commercial of the '50's. This is obtained by a 17% increase in tons of roots per acre and a 5% increase in recoverable white sugar per ton.

The 1973 area evaluation tests were designed to test various combinations of the 550 inbred O-type lines. Since there was an emergence problem in all four of the tests, we suspect the quality of seed. The average stand in the test that was saved for harvest was 78%. An analysis of these data was made for general combining ability in hybrid combinations according to male and female parents. There was no general combining ability for yield, however, there was some general combining ability for both males and females in percent sucrose. SP70P23 and SP6528-0 both exhibited better combining ability for percent sucrose than did SP66288-24. As a female parent SP71550-01 had higher general combining ability for percent sucrose than did its combinations with other O-types for an F_1 female hybrid.

1973, 6x6 LSQ tests, Data as % of Performance of General Mean (G.M.)

Item	Location Code**	Variety Code@ 1	2	3	4	5	6	LSD 5 % on % G.M.	Actual G.M.	C.V.%
Re-	3*	85.0	98.9	113.3	94.7	101.4	106.7	8.6	8100 lbs	6.55
cover-	4	87.6	97.7	108.6	92.2	109.9	103.9	8.2	5473 lbs	6.78
able	2¢	87.3	97.5	114.3	93.2	101.7	105.9	9.6	4640 lbs	8.00
white	5	97.1	98.6	105.6	98.7	98.3	101.7	NS	7069 lbs	6.11
sugar	6*¢	91.3	95.1	112.3	91.6	104.6	105.0	11.8	6334 lbs	8.98
per acre	Mich Avg	89.7	97.6	110.8	94.1	103.2	104.6	4.9	100 %	3.71
	7¢	83.1	106.2	104.7	101.4	104.2	100.4	6.1	4766 lbs	5.08
	Grand Avg	88.6	99.0	109.8	95.3	103.4	103.9			
Roots-	3*	88.4	94.6	113.1	93.3	103.5	107.1	7.4	25.9 tons	5.60
Tons/	4	95.8	94.7	108.0	90.5	108.7	102.3	8.0	17.9 tons	6.66
Acre	2¢	94.2	92.6	114.9	90.6	101.9	105.8	8.9	16.3 tons	7.37
	5	100.8	94.2	108.0	94.4	100.2	102.4	7.3	22.7 tons	6.02
	6*¢	94.4	92.7	115.0	89.6	103.4	104.7	11.0	22.8 tons	8.35
	Mich Avg	94.7	93.8	111.8	91.7	103.5	104.5	4.3	100 %	3.23
	7¢	93.3	97.7	108.6	92.7	105.5	102.1	4.4	22.2 tons	3.64
	Grand Avg	94.5	94.4	111.3	91.9	103.9	104.1			
Re-	3*	96.1	104.5	100.3	101.6	97.8	99.7	3.4	312.2 lbs	2.61
cover-	4	91.7	103.1	100.6	101.8	101.3	101.4	4.0	305.6 lbs	3.35
able	2¢	92.9	105.3	99.3	102.9	99.8	99.8	5.0	284.7 lbs	4.19
white	5	96.2	104.4	97.7	104.4	97.9	99.3	4.9	311.6 lbs	4.03
sugar	6*¢	96.5	102.3	97.6	102.2	101.1	100.4	4.2	277.7 lbs	3.18
per ton	Mich Avg	94.7	103.9	99.1	102.6	99.6	100.1	2.1	100 %	1.62
of	7¢	89.0	108.5	96.4	109.3	98.5	98.3	4.2	215.0 lbs	3.45
roots	Grand Avg	93.7	104.7	98.7	103.7	99.4	99.8			

¢,*, **, @, see page E6

1973, 6x6 LSQ tests, Data as % of Performance of General Mean (G.M.)

Item	Location Code**	Variety Code@ 1	2	3	4	5	6	LSD 5 % on % G.M.	Actual G.M.	C.V.%
% Sucrose	3*	97.7	104.0	99.9	101.3	97.5	99.5	3.3	18.02 pct	2.47
	4	94.0	102.9	99.9	101.7	100.8	100.7	3.4	17.79 pct	2.81
	2¢	95.7	104.1	99.0	102.1	100.1	99.0	4.1	17.01 pct	3.41
	5	98.1	102.6	97.5	103.6	98.4	99.8	4.2	18.52 pct	3.47
	6*¢	98.1	102.0	97.9	101.7	100.7	99.4	3.1	16.62 pct	2.33
	Mich Avg	96.7	103.1	98.8	102.1	99.5	99.7	1.7	100 %	1.32
	7¢	92.4	106.4	97.0	107.1	99.1	98.0	3.1	13.58 pct	2.54
	Grand Avg	96.0	103.7	98.5	102.9	99.4	99.4			
% CJ purity	3*	99.1	100.2	100.3	100.1	100.3	100.1	0.6	95.66 pct	0.46
	4	98.7	100.1	100.5	100.1	100.3	100.4	0.5	95.21 pct	0.39
	2¢	98.5	100.6	100.2	100.4	99.9	100.5	0.7	93.91 pct	0.56
	5	99.0	100.9	100.2	100.4	99.7	99.8	0.5	94.03 pct	0.44
	6*¢	99.1	100.1	99.9	100.2	100.2	100.5	0.8	93.91 pct	0.58
	Mich Avg	98.9	100.4	100.2	100.2	100.1	100.3	0.4	100 %	0.29
	7¢	98.4	100.9	99.8	100.9	99.8	100.3	0.7	91.71 pct	0.60
	Grand Avg	98.9	100.5	100.2	100.4	100.0	100.3			
Beets per 100' of row	3*	95.8	102.4	113.0	86.9	99.8	102.1	6.2	94.6 beets	4.72
	4	101.3	98.0	109.0	84.6	105.1	102.0	7.3	91.6 beets	6.10
	2¢	97.8	98.7	121.1	86.0	99.8	96.6	11.9	61.4 beets	9.84
	5	106.6	104.2	106.6	93.7	93.9	95.0	7.6	77.9 beets	6.33
	6*¢	99.1	101.1	102.3	95.7	106.6	95.3	NS	88.8 beets	10.42
	Mich Avg	100.1	100.9	110.4	89.4	101.0	98.2	6.9	100 %	5.24
	7¢	99.4	102.3	108.4	95.2	100.7	94.0	5.9	78.9 beets	4.87
	Grand Avg	100.0	101.1	110.0	90.4	101.0	97.5			

¢,*, **, @, see page E6

1973, 6x6 LSQ tests, Data as % of Performance of General Mean (G.M.)

Item	Location Code**	Variety Code@ 1	2	3	4	5	6	LSD 5 % on % G.M.	Actual G.M.	C.V.%
Fiber	3*	141.5	17.6	117.1	16.6	97.6	209.8	47.4	20.5 pct	35.94
	6*¢	109.1	40.9	109.1	47.7	81.8	211.4	35.8	14.7 pct	27.20
	Mich Avg	125.3	29.3	113.1	32.2	89.7	210.6	43.6	100 %	16.96
	7¢	135.9	67.9	110.4	62.3	101.9	121.7	40.7	29.4 pct	33.80
	Grand Avg	128.8	42.1	112.2	42.2	93.8	181.0			
Leaf spot	4	123.9	78.3	97.8	71.7	123.9	104.3	15.7	2.55 read.	13.04
	7¢	115.7	57.8	108.4	57.8	144.6	115.7	33.5	2.31 read.	27.81
	Grand Avg	119.8	68.1	103.1	64.8	134.3	110.0			

¢,*, **, @, see page E6

Footnotes and notes concerning the 1973 6x6 Latin Square Tests

@ Variety Code

Entry No.			
1	SP64401-0		(US 401)
2	SP71550-01	x SP6822-0	(US H21)
3	UI(11866 x 12166)	x SP6322-0	(US H20)
4	SP(69557-01 x 69550-0)	x SP6922-0	
5	UI(11866 x 12166)	x 70P21	
5A	" "	x 70P23	
6	UI(100363 x 12163)	x SP6528-01	

** Location Code

2 - B & B Farm, Saginaw, Michigan
*3 - Tom Schindler, Bay City, Michigan
4 - Howard Hayward, Bay City, Michigan
5 - Rudy Hetzner, Saginaw, Michigan
*6 - Wallace Koeppendoerfer, Richville, Michigan
7 - James Schroeder, Ottawa, Ohio

* One column missing hence analyzed as a 5 replication RCB with columns as replications.

¢ Variety 5A planted instead of variety 5. The pollinators of both varieties are related.

The 6x6 Latin Square Tests are based on data from 4-row plots 30 feet long with 28" rows in Michigan and 30" rows in Ohio. The data from each test were analyzed on an actual basis then converted to percent of the General Mean for summary purposes. Summary data are calculated from the percentage performance data. This technique gives each test an equal value in a combined analysis. Thus test (location) effects are zero, but the values of the interactions involving tests are still present and valid. This is especially helpful when years are involved since the effect of years per.se. are removed, but not the interactions involving years.

Area Evaluation, Tom Schindler, Bay City, 1973

HYBRID CMS "0" Pollen	# Rec. White Su/A	Tons Roots /Acre	# Rec. White Su/ton	% Sucrose	% C.J. Purity	Beets per 100'	% Fiber	Aphanomyces Score (Part of larger test)	Leaf Spot Rating East Lansing	Leaf Spot Rating Beltsville
	PERFORMANCE IN PERCENT OF THE TEST MEAN									
SP69550-01 x UI12166 x SP6822-0	104.2	105.6	98.6	98.5	100.1	100.0	109.0	98.4	135.0+	117.1
SP69550-01 x UI12166 x SP6528-01	100.1	101.9	98.0	96.9	100.7	105.3	72.1	102.7	122.7	126.1
SP69550-01 x UI12166 x 70P23	99.1	100.4	98.7	98.3	100.3	110.6	63.7	95.4	110.4	135.1
SP69550-01 x UI12166 x SP66288-24	92.0	95.8	96.0	95.5-	100.4	103.2	62.0	96.5	85.9	90.1
SP(69514-01x69550-0) x SP6822-0	101.8	100.9	100.8	100.7	100.0	102.7	100.6	95.6	85.9	81.1
SP(69514-01x69550-0) x SP6528-01	97.2	95.1	102.3	101.3	100.5	84.6-	92.2	102.4	110.4	99.1
SP(69514-01x69550-0) x 70P23	94.1	93.7	100.3	100.8	99.7	85.1-	164.3	98.6	85.9	81.1
SP(69514-01x69550-0) x SP66288-24	103.9	105.0	99.0	99.8	99.6	107.4	103.9	91.6	49.1-	63.1
SP71550-01 x SP6528-01	107.0	103.0	104.0	103.6+	100.1	109.0	30.2		98.2	99.1
SP71550-01 x 70P23	91.9	87.4-	105.1+	104.1+	100.4	102.7	43.6		85.9	90.1
SP71550-01 x SP66288-24	94.0	91.9	102.3	102.1	100.1	92.0	48.6		73.6	81.1
SP69550-01 x SP6322-0	91.8	95.6	95.7-	96.1-	99.8	83.5-	62.0		85.9	81.1
SP(69557-01x69550-0) x SP6528-01	104.4	103.8	100.6	101.3	99.5	88.8	53.6	107.8	98.2	90.1
SP(69557-01x69550-0) x 70P23	96.2	92.4	104.1	103.8+	100.1	101.6	38.5	98.5	73.6	108.1
SP(69557-01x69550-0) x SP66288-24	99.1	99.6	99.4	99.8	99.8	98.9	31.8	100.5	61.4-	72.1
UI(100363x12163) x SP6822-0	109.1	111.9+	97.4	98.6	99.4	109.6	293.4+	97.6	147.2+	126.1
UI(1861x2161) x SP6822-0	103.3	106.6	96.8	97.8	99.5	95.2	184.4+	89.4	147.2+	126.1
UI(1861x2161) x SP66288-24	101.9	102.9	98.7	98.5	99.6	104.8	150.9	96.3	110.4	126.1
SP70550-01 x SP6922-0	100.7	102.1	98.5	98.9	99.8	115.4+	184.4+		110.4	90.1
SP(70550-01x7042-0) x SP6922-0	108.0	104.3	103.6	103.5+	100.0	99.5	110.6		122.7	117.1
LSD 5% (for above data units)	10.7	9.6	4.3	3.4	0.7	12.1	71.4	11.6	27.2	-
General Mean (actual)	7378	24.2	305.5	17.93	94.77	78.3	9.94	3.74	2.7	3.7
Coefficient of Variation (%)	9.37	8.42	3.74	2.99	0.65	10.59	62.30	10.23	16.42	-

USDA-3 Variety tests, Torrington, Wyoming, 1973

Randomized Complete Block
9 replications, 1 row plot
25 ft long, 22 in. between rows

Holly Sugar Corporation
Planted May 8, 1973
Harvested Oct. 15, 1973

HYBRID			Extractable Sugar per Acre	Extractable Sugar per Ton	Gross Sugar per Acre	Beets Acre	Sucrose	Beets/ 100 ft	Bolting
CMS	"O"	Pollen	Pounds	Pounds	Pounds	Tons	Percent	Number	Percent
UI100363	x EL36	x 70P23	6239.	247.4	7988.	25.3	15.81	125.	0.0
SP6923-01	x UI12166	x SP6822-0	6178.	242.6	7945.	25.4	15.62	119.	0.4
UI100363	x UI12163	x SP6822-0	6137.	244.1	7896.	25.3	15.67	131.	0.0
UI100363	x UI12163	x 70P23	6111.	264.5	7605.	23.0	16.48	129.	0.0
UI100363	x UI12163	x SP66288-24	6064.	-239.1	7856.	25.5	-15.46	137.	0.0
UI100363	x EL36	x SP6528-01	5979.	-227.4	7895.	+26.5	-14.98	120.	1.1
SP6923-01	x UI12166	x 70P23	5956.	253.7	7542.	23.5	16.05	127.	0.0
69B5x02	x EL36	x 70P23	5788.	252.8	7341.	23.0	16.02	125.	0.7
69B5x02	x EL36	x SP6528-01	5729.	-233.6	7449.	24.4	-15.22	131.	0.7
UI104366B	x EL36	x SP6822-0	5709.	-235.6	7416.	24.2	-15.31	130.	0.0
UI100363	x UI12163	x SP6528-01	5565.	253.9	7031.	21.8	16.08	132.	0.0
UI104366B	x EL36	x SP6528-01	5543.	-226.3	7295.	24.4	-14.91	118.	1.5
SP6926-01	x EL36	x SP6822-0	5490.	-219.2	7337.	25.2	-14.62	118.	0.4
SP6923-01	x UI12166	x SP6528-01	5461.	242.5	7033.	22.5	15.62	135.	0.0
SP6923-01	x EL36	x SP6822-0	5435.	-220.1	7257.	25.0	-14.64	123.	0.7
SP6926-01	x EL36	x 70P23	5401.	-240.0	6986.	22.6	-15.49	130.	0.0
SP6923-01	x EL36	x 70P23	5232.	-241.8	6738.	21.7	-15.56	114.	0.0
SP6923-01	x EL36	x SP6528-01	5230.	-231.7	6850.	22.6	-15.17	120.	0.4
SP6926-01	x EL36	x SP68528-01	-5138.	-223.1	6801.	22.9	-14.79	123.	1.1
Grand Mean			5867.	242.6	7547.	24.2	15.60	127.	0.3
Least Significant Difference			760.	18.6	927.	3.0	0.79		
Coefficient of Variation			14.	8.3	13.	13.5	5.41		
Standard Error of the Mean			272.	6.7	332.	1.1	0.28		
Calculated F Value for Varieties			3.72**	4.64**	3.03**	2.16**	4.51**		

USDA-4 Variety tests, Torrington, Wyoming, 1973

Randomized Complete Block
9 replications, 1 row plot
25 ft long, 22 in. between rows

Holly Sugar Corporation
Planted May 8, 1973
Harvested Oct. 15, 1973

HYBRID			Extractable Sugar per Acre	Extractable Sugar per Ton	Gross Sugar per Acre	Beets Acre	Sucrose	Beets/ 100 ft	Bolting
CMS	"O"	Pollen	Pounds	Pounds	Pounds	Tons	Percent	Number	Percent
SP69557-01		x SP6922-0	5312.	238.8	6870.	22.2	15.45	127.	2.1
SP69550-01		x SP6934-0	5269.	237.2	6837.	22.3	15.37	132.	1.4
SP70550-01	x 7042-0	x SP6922-0	-4966.	244.8	-6377.	-20.4	15.70	125.	3.2
SP69557-01		x SP70288-24	-4867.	252.5	-6167.	-19.2	16.01	132.	0.3
SP70618-01		x SP70288-24	-4803.	233.7	-6245.	-20.5	15.22	125.	0.0
SP70550-01		x SP6922-0	-4782.	-219.6	-6345.	-21.6	-14.60	129.	0.3
SP69523-01	x 69550-0	x SP6922-0	-4722.	254.9	-5958.	-18.4	16.12	131.	0.3
SP70557-01		x SP6528-01	-4541.	238.2	-5884.	-19.1	15.43	120.	4.4
SP70550-01		x SP6528-01	-4526.	-216.2	-6041.	-20.8	-14.45	123.	0.7
SP69557-01		x SP7035-0	-4255.	242.0	-5470.	-17.5	15.58	123.	3.6
SP67550-01	x 68745.A	x SP6922-0	-4186	-218.9	-5568.	-19.1	-14.57	113.	1.2
SP70550-01		x SP70288-24	-4162.	-214.9	-5577.	-19.2	-14.44	117.	0.8
SP70550-01		x SP7035-0	-3990.	229.1	-5219.	-17.3	15.01	137.	1.0
Grand Mean			4874.	234.9	6330.	20.7	15.27	126.	1.2
Least Significant Difference			791.	22.6	935.	2.9	0.97		
Coefficient of Variation			17.	10.3	16.	15.0	6.82		
Standard Error of the Mean			283.	8.1	334.	1.0	0.35		
Calculated F Value for Varieties			5.68**	2.72**	6.00**	5.58**	2.73**		

Test 34117 - Rocky Ford, Colorado, 1973

Equalized Random Block
4 replications, 1-row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.

HYBRID CMS	"O"	Pollen	Beets Acre Tons	Sucrose Percent	GROSS Sugar per Acre Pounds
U&I104366B	x	SP6822-0	29.07	11.32	6528.7
SP6926-01	x	SP6322-0	31.46	10.93	6857.2
U&I104367	x	SP6322-0	30.54	11.48	7056.0
U&I102167E	x	SP6822-0	29.39	12.40	7240.2
SP68550-01	x	SP6322-0	27.53	11.42	6281.7
American #2 Hybrid "B"			30.95	12.17	7523.2
U&I(100363x12163)	x	SP66288-24	27.23	11.57	6072.1
(SP69550-01xU&I12166)	x	SP66288-24	27.89	11.61	6483.5
(SP69557-01xSP69550-0)	x	SP66288-24	22.34	12.25	5535.4
U&I104367	x	SP66288-24	28.11	11.58	6507.5
(SP69514-01xSP69550-0)	x	SP66288-24	25.12	12.46	6263.8
SP71550-01	x	SP66288-24	23.98	12.47	5965.5
FC506ms	x	SP66288-24	25.61	11.47	5863.5
U&I(1861x2161)	x	SP66288-24	28.47	11.87	6771.0
(SP6926-01xU&I12166)	x	SP66288-24	28.58	10.70	6129.9
(SP6926-01xEL-36)	x	SP66288-24	28.17	10.92	6126.8
(SP69550-01x EL-36)	x	SP66288-24	24.68	11.33	5606.8
American #2 Hybrid "B"			30.70	12.55	7693.2
U&I118566	x	SP66288-24	27.09	11.83	6422.0
U&I118566	x	SP6528-01	28.25	12.45	7004.6
EL-36	x	SP6528-01	28.52	10.71	6100.0
SP71550-01	x	SP6528-01	23.46	13.02	6087.9
FC506ms	x	SP6528-01	22.60	12.64	5555.6
EL-38	x	SP6528-01	25.41	10.62	5447.6
Overall Mean			27.30	11.74	6380.2
LSD (5%)			3.5567	.8205	948.6600
Coefficient of Variation			9.2135	4.9475	10.5144

Test 34118 - Rocky Ford, Colorado, 1973

Equalized Random Block
4 replications, 1-row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.

HYBRID CMS	"O"	Pollen	Beets Acre Tons	Sucrose Percent	GROSS Sugar per Acre Pounds
SP7042-01		x SP6528-01	28.53	11.71	6679.9
U&I104367		x SP6528-01	32.67	12.07	7898.8
SP6926-01		x SP6528-01	28.86	11.64	6674.8
SP(69557x69550-0)		x 6528-01	21.46	12.63	5427.0
(100363x12163)		x 6528-01	29.51	12.00	7099.2
American #2 Hybrid B			32.44	12.12	7886.3
(69550-01xEL-36)		x SP6528-01	26.36	11.75	6190.3
(11866xEL-36)		x 6528-01	28.86	11.78	6812.8
(69Bx02xEL-36)		x 6528-01	29.23	11.95	6994.3
(104366BxEL-36)		x 6528-01	27.66	12.32	6814.8
(12166xEL-36)		x 6528-01	29.21	11.80	6909.8
(SP7042-01xEL-36)		x SP6528-01	26.98	11.85	6422.4
(102167ExEL-36)		x 6528-01	29.58	12.42	7346.1
(6923-01xEL-36)		x 6528-01	25.27	11.72	5936.5
(199363xEL-36)		x 6528-01	27.93	11.97	6722.0
(6926-01xEL-36)		x 6528-01	29.86	11.93	7116.1
FC506msxEL-36		x 6528-01	25.05	12.27	6151.5
American #2 Hybrid B			30.97	11.63	7223.9
(69514-01x69550-0)		x SP6528-01	24.66	12.87	6369.6
(6923-01x12166)		x 6528-01	27.41	11.86	6474.9
(6926-01x12166)		x 6528-01	30.71	12.15	7455.8
(EL-36xU&I12166)		x 6528-01	28.01	11.92	6684.0
(7042-01x12166)		x 6528-01	25.79	12.54	6460.8
(69B5x02x12166)		x 6528-01	28.37	11.99	6811.0
Overall Mean			28.14	12.04	6773.4
LSD (5%)			4.0755	.8392	1112.3373
Coefficient of Variation			10.2563	4.9372	11.6303

Test 34119 - Rocky Ford, Colorado, 1973

Equalized Random Block
4 replications, 1-row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.

HYBRID CMS "O"	Pollen	Beets Acre Tons	Sucrose Percent	GROSS SUgar per Acre Pounds
(104366Bx12166)	x 6528-01	29.85	11.69	7033.8
(69550-01x12166)	x 6528-01	26.30	11.50	6054.2
(102167Ex12166)	x 6528-01	28.57	11.31	6481.5
(FC506msx12166)	x 6528-01	30.17	11.49	6948.5
(1861x2161)	x SP6528-01	31.07	12.20	7601.6
American #2 Hybrid B		35.61	11.61	8275.0
(SP6926-01x12166)	x 70P23	32.06	10.98	7055.3
(69550-01x12166)	x 70P23	27.03	12.33	6673.9
(104366Bx12166)	x 70P23	24.21	11.75	5816.1
(102167Ex12166)	x 70P23	29.00	11.83	6849.2
(69Bx02x12166)	x 70P23	30.24	11.55	6977.8
(EL-36x12166)	x70P23	28.05	11.35	6396.2
(6923-01x12166)	x 70P23	30.42	11.53	7040.0
(7042-01x12166)	x 70P23	27.87	11.43	6421.2
(FC506msx12166)	x 70P23	27.99	12.21	6863.4
(7042-01xEL-36)	x 70P23	29.32	11.65	6840.2
(FC506msxEL-36)	x 70P23	29.11	11.62	6800.7
American #2 Hybrid B		34.77	11.60	8041.0
(6923-01xEL-36)	x 70P23	29.64	11.05	6582.3
(102167ExEL-36)	x 70P23	29.55	11.76	6989.3
(69B5x02xEL-36)	x 70P23	30.42	11.70	7112.9
(69550-01xEL-36)	x 70P23	25.79	11.90	6136.4
(6926-01xEL-36)	x 70P23	32.56	11.71	7716.1
(104366BxEL-36)	x 70P23	32.91	11.82	7772.6
Overall Mean		29.69	11.65	6936.6
LSD (5%)		6.0110	.7520	1460.8358
Coefficient of Variation		14.3395	4.5721	14.9147

Test 34120 - Rocky Ford, Colorado, 1973

Equalized Random Block
4 replications, 1-row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.

HYBRID CMS "O"	Pollen	Beets Acre Tons	Sucrose Percent	GROSS Sugar per Acre Pounds
(11866xEL-36)	x 70P23	31.18	12.52	7749.2
(100363xEL-36)	x 70P23	30.14	12.14	7188.5
(69557-01x69550-0)	x 70P23	23.43	13.32	6179.6
(69514-01x69550-0)	x 70P23	23.76	12.46	5892.3
SP6926-01	x 70P23	29.93	11.94	7135.8
American #2 Hybrid B		31.29	12.20	7588.4
EL-36	x 70P23	27.30	11.50	6291.6
SP7042-01	x 70P23	26.65	12.64	6769.0
EL-38	x 70P23	31.49	10.77	6769.1
U&I118566	x 70P23	29.92	13.26	7861.4
U&I104367	x 70P23	32.51	12.16	7924.0
SP70550-01	x SP7035-0	20.55	11.62	4790.3
SP70618-01	x SP7035-0	26.08	11.00	5770.5
SP69557-01	x SP7034-0	25.60	12.55	6445.2
SP69533-01	x SP70288-24	27.84	11.52	6397.7
SP70618-01	x SP70288-24	25.58	11.67	5964.5
SP70550-01	x SP70288-24	25.34	11.20	5697.1
American #2 Hybrid B		33.27	11.69	7801.8
SP69557-01	x SP70288-24	23.98	12.60	6065.3
SP70730-01	x SP70288-24	22.49	12.21	5472.1
(70527-01x7042-0)	x 6922-0	27.46	12.27	6722.0
(69524-01x7042-0)	x 6922-0	26.54	12.09	6412.6
(6621-01x7042-0)	x 6922-0	27.86	11.56	6376.0
SP71569-01	x SP6922-0	23.31	12.30	5749.9
Overall Mean		27.23	12.05	6542.2
LSD (5%)		4.7827	.8220	1183.5517
Coefficient of Variation		12.4395	4.8316	12.8122

Test 38119 - East Grand Forks, Minnesota, 1973

Equalized Random Block
4 replications, 1-row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.

HYBRID			Beets Acre Tons	Sucrose Percent	GROSS Sugar per Acre Pounds
CMS	"O"	Pollen			
U&I104366B	x	SP6822-0	19.38	14.23	5510.5
SP6926-01	x	SP6322-0	20.66	13.38	5513.5
U&I104367	x	SP6322-0	21.27	14.13	6007.2
U&I102167E	x	SP6822-0	20.14	14.09	5674.5
SP68550-01	x	SP6322-0	18.30	13.68	4996.7
American #2 Hybrid B			20.43	14.21	5797.9
(100363x12163)	x	66288-24	20.91	14.00	5841.4
(69550-01x12166)	x	6628-24	19.50	14.07	5487.8
(69557-01x69550-0)	x	6628-24	16.68	14.58	4869.2
U&I104367	x	SP66288-24	20.75	13.68	5640.9
(69514-01x69550-0)	x	SP66288-24	17.05	13.91	4729.8
SP71550-01	x	SP66288-24	15.90	14.56	4623.1
FC506ms	x	SP66288-24	18.27	14.37	5227.8
(1861x2161)	x	SP66288-24	19.16	14.08	5389.6
(6926-01x12166)	x	66288-24	19.35	13.94	5373.1
(6926-01xEL-36)	x	66288-24	19.45	13.57	5270.5
(69550-01xEL-36)	x	66288-24	18.95	13.97	5280.9
American #2 Hybrid B			19.81	14.35	5658.8
U&I118566	x	SP66288-24	20.41	13.54	5509.4
U&I118566	x	SP6528-01	19.47	14.07	5464.1
EL-36	x	SP6528-01	19.50	13.65	5329.7
SP71550-01	x	SP6528-01	14.41	14.63	4237.3
FC506ms	x	SP6528-01	18.89	14.28	5403.0
EL-38	x	SP6528-01	19.13	13.74	5243.9
Overall Mean			19.07	14.03	5336.7
LSD (5%)			2.3955	.4447	672.7590
Coefficient of Variation			8.8921	2.2441	8.9254

Test 38120 - East Grand Forks, Minnesota, 1973

Equalized Random Block
4 replications, 1-row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.

HYBRID CMS	"O"	Pollen	Beets Acre Tons	Sucrose Percent	GROSS Sugar per Acre Pounds
SP7042-01	x	SP6528-01	20.15	13.98	5621.1
U&I104367	x	SP6528-01	22.50	13.79	6193.9
SP6926-01	x	SP6528-01	20.25	13.57	5488.0
(69557x69550-0)	x	6528-01	16.66	14.30	4765.6
(100363x12163)	x	6528-01	20.57	14.02	5749.4
American #2 Hybrid B			20.25	13.69	5552.5
(69550-01xEL-36)	x	6528-01	19.37	14.10	5446.0
(11866xEL-36)	x	6528-01	21.66	13.60	5879.5
(69B5x02) x EL-36	x	6528-01	20.77	13.63	5672.1
(104366BxEL-36)	x	6528-01	20.48	13.91	5676.6
(12166xEL-36)	x	6528-01	20.60	14.17	5830.2
(7042-01 x EL-36)	x	6528-01	19.31	13.86	5346.4
(12167ExEL-36)	x	6528-01	20.96	14.10	5898.6
(6923-01xEL-36)	x	6528-01	22.33	13.74	6134.4
(100363xEL-36)	x	6528-01	20.88	13.69	5708.2
(6926-01xEL-36)	x	6528-01	22.61	14.06	6382.2
(FC506msxEL-36)	x	6528-01	22.43	13.77	6180.8
American #2 Hybrid B			20.48	14.22	5817.8
(69514-0x69550-0)	x	6528-01	18.75	14.04	5267.6
(6923-01x12166)	x	6528-01	20.94	14.17	5926.8
(6926-01x12166)	x	6528-01	19.50	14.19	5530.7
(EL-36x12166)	x	SP6528-01	21.78	14.11	6146.6
(7042-01x12166)	x	6528-01	18.19	14.09	5128.2
(69B5x02)	x	SP6528-01	20.20	14.00	5658.4
Overall Mean			20.48	13.95	5708.4
LSD (5%)			2.5416	.4048	745.6260
Coefficient of Variation			8.7869	2.0547	9.2506

Test 38121 - East Grand Forks, Minnesota, 1973

Equalized Random Block
4 replications, 1-row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.

HYBRID CMS "O"	Pollen	Beets Acre Tons	Sucrose Percent	GROSS Sugar per Acre Pounds
(104366Bx12166)	x 6528-01	20.81	13.72	5703.6
(69550-01x12166)	x 6528-01	20.87	13.79	5758.2
(102167Ex12166)	x 6528-01	21.01	13.88	5803.5
(FC506msx12166)	x 6528-01	19.95	13.90	5537.2
(1861x2161)	x 6528-01	19.65	13.82	5429.9
American #2 Hybrid B		21.99	13.89	6094.9
(6926-01x12166)	x 70P23	21.68	13.97	6042.6
(69550-01x12166)	x 70P23	20.07	14.17	5675.6
(104366Bx12166)	x 70P23	20.40	14.03	5699.7
(102167Ex12166)	x 70P23	20.51	14.37	5883.7
(69B5x02x12166)	x 70P23	21.01	13.92	5849.7
(EL-36x12166)	x 70P23	21.20	14.15	5986.8
(6923-01x12166)	x 70P23	21.62	13.81	5949.6
(7042-01x12166)	x 70P23	20.54	14.07	5765.8
(FC506msx12166)	x 70P23	19.92	14.31	5697.0
(7042-01xEL-36)	x 70P23	19.92	14.30	5677.6
(FC506msxEL-36)	x 70P23	19.60	13.93	5471.6
American #2 Hybrid B		21.91	14.21	6223.8
(6923-01xEL-36)	x 70P23	23.22	13.71	6365.3
(102167ExEL-36)	x 70P23	20.75	14.24	5904.5
(69B5x02xEL-36)	x 70P23	19.66	14.08	5537.0
(69550-01xEL-36)	x 70P23	18.54	14.53	5382.6
(6926-01xEL-36)	x 70P23	21.36	13.78	5881.9
(104366ExEL-36)	x 70P23	21.11	13.77	5810.6
Overall Mean		20.72	14.02	5797.2
LSD (5%)		2.0888	.4266	567.8909
Coefficient of Variation		7.1391	2.1555	6.9376

Test 38122 - East Grand Forks, Minnesota, 1973

Equalized Random Block
4 replications, 1-row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.

HYBRID CMS "O"	Pollen	Beets Acre Tons	Sucrose Percent	GROSS Sugar per Acre Pounds
(U&I11866xEL-36)	x 70P23	20.26	14.10	5707.9
(U&I100363xEL-36)	x 70P23	20.31	14.42	5856.6
(SP69557-01xSP69550-0)	x 70P23	14.97	14.62	4376.8
(69514-01x69550-0)	x 70P23	17.42	14.87	5175.6
SP6926-01	x 70P23	21.01	13.93	5856.4
American #2 Hybrid B		20.10	14.25	5716.5
EL-36	x 70P23	21.10	13.99	5902.5
SP7042-01	x 70P23	18.74	14.47	5410.2
EL-38	x 70P23	21.44	13.72	5879.9
U&I118566	x 70P23	20.47	14.63	5984.0
U&I104367	x 70P23	21.72	14.40	6250.2
SP70550-01	x SP7035-0	17.47	14.37	5029.0
SP70618-01	x SP7035-0	20.13	14.05	5654.2
SP69557-01	x SP7035-0	17.40	14.47	5031.6
SP69533-01	x SP70288-24	19.33	14.04	5428.3
SP70618-01	x SP70288-24	20.49	13.84	5662.8
SP70550-01	x SP70288-24	16.20	14.32	4638.1
American #2 Hybrid B		20.87	14.22	5933.3
SP69557-01	x SP70288-24	18.47	14.58	5376.1
SP70730-01	x SP70288-24	18.24	14.37	5239.6
SP70527-01 x 7042-0	x 6922-0	18.48	14.36	5306.5
SP69524-01 x 7042-0	x 6922-0	18.74	14.05	5268.7
SP6621-01 x 7042-0	x 6922-0	20.48	13.73	5620.8
SP71569-01	x SP6922-0	17.87	14.64	5230.8
Overall Mean		19.24	14.27	5480.7
LSD (5%)		1.9951	.4767	527.8000
Coefficient of Variation		7.3445	2.3661	6.8202

Test 34509 - Rocky Ford, Colorado, 1973

Equalized Random Block
6 replications, 2 row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.

HYBRID		Recoverable Sugar per Acre	Recoverable Sugar Per Ton	Beets Acre	Sucrose	Known Sugar Loss/Acre	Sugar Recovery
CMS "0"	Pollen	Pounds	Pounds	Tons	Percent	Pounds	Percent
American #2 Hybrid B		4565.8	174.03	26.47	11.42	1456.3	75.99
U&I(100363x12163)	x 70P23	5123.2	189.52	26.60	11.91	1296.2	79.26
SP6926-01	x 70P21	4559.1	180.83	25.29	11.52	1258.4	78.40
U&I(11866x12166)	x SP6822-0	4405.7	174.47	25.43	11.26	1295.2	77.27
FC506ms	x 70P23	3950.7	174.39	22.49	11.46	1233.2	75.56
SP71550-01	x 70P23	3739.8	194.99	19.21	12.17	936.6	79.99
U&I(1861x2161)	x 70P23	4871.6	195.94	25.00	12.26	1235.7	79.66
(100363x12163)	x 70P21	4579.1	178.11	25.88	11.46	1332.6	77.57
(12166x12163)	x 70P23	4500.4	171.12	26.17	11.22	1405.7	76.10
SP69550-01	x SP6322-0	3635.3	186.54	19.55	11.70	937.7	79.45
SP69557-01	x SP6922-0	3871.2	178.32	21.83	11.53	1148.4	77.14
(SP70550-01x7042-0)	x SP6922-0	3518.0	166.69	20.92	11.06	1150.0	75.03
Overall Mean		4276.7	180.41	23.74	11.58	1223.8	
LSD (5%)		746.9949	19.3163	2.6916	.8777	194.9611	
Coefficient of Variation		15.0606	9.2318	9.7772	6.5339	13.7358	

Test 34509 - (continued) Rocky Ford, Colorado, 1973

Equalized Random Block
6 replications, 2 row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.

HYBRID CMS "O"	Pollen	Raffinose	Kestose	Sodium	Potassium	Amino Nitrogen	Impurity Index Carrouthers Formula
		Percent on Beet		Parts per million			
American #2 Hybrid B		.10	.01	1711.9	2799.2	574.2	1600.8
U&I(100363x12163)	x 70P23	.09	.01	1618.3	2453.6	495.1	1382.8
SP6926-01	x 70P21	.09	.01	1873.9	2343.3	457.8	1439.7
U&I(11866x12166)	x SP6822-0	.10	.01	1743.3	2641.7	466.1	1515.5
FC506ms	x70P23	.09	.01	2123.3	2418.3	535.3	1629.1
SP71550-01	x "	.11	.01	1306.7	2433.1	610.7	1333.9
U&I(1861x2161)	x "	.10	.01	1610.0	2383.3	537.0	1355.9
(100363x12163)	x 70P21	.10	.01	1775.6	2396.9	534.8	1495.0
(12166x12163)	x 70P23	.09	.01	1906.7	2446.7	553.8	1593.6
SP69550-01	x SP6322-0	.09	.01	1667.8	2331.1	461.7	1370.3
SP69557-01	x SP6922-0	.09	.01	1718.3	2698.3	520.9	1524.2
(SP70550-01 x 7042-0)	x SP6922-0	.10	.01	1761.7	2658.6	596.1	1664.4
Overall Mean		.10	.01	1734.8	2500.3	528.6	1492.1
LSD (5%)		.0191	.0032	281.3092	272.8846	85.8522	204.2567
Coefficient of Variation		16.9963	23.2410	13.9819	9.4104	14.0033	11.8034

Test 38502 - East Grand Forks, Minnesota, 1973

Equalized Random Block
6 replications, 2-row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.

HYBRID CMS "0"	Pollen	Recoverable Sugar per Acre Pounds	Recoverable Sugar per Ton Pounds	Beets Acre Tons	Sucrose Percent	Known Sugar Loss/Acre Pounds	Sugar Recovery Percent
American #2 Hybrid B		5465.8	245.58	22.27	13.95	745.2	88.00
U&I(100363x12163)	x 70P23	5187.4	242.07	21.42	13.84	744.3	87.43
SP6926-01	x 70P21	5026.0	238.22	21.12	13.57	700.5	87.77
U&I(11866x12166)	x SP6822-0	5183.0	234.23	22.13	13.46	771.6	87.04
FC506ms	x 70P23	4990.6	251.00	19.89	14.20	656.3	88.37
SP71550-01	x 70P23	4528.9	262.44	17.27	14.82	588.6	88.50
U&I(1861x2161)	x 70P23	5227.0	247.86	21.10	14.12	726.8	87.74
(100363x12163)	x 70P21	5298.8	246.10	21.60	14.18	811.1	86.78
(12166x12163)	x 70P23	5381.5	245.04	21.98	14.10	811.9	86.89
SP69550-01	x SP6322-0	4776.0	248.15	19.23	14.04	630.3	88.35
SP69557-01	x SP6922-0	4487.8	242.98	18.52	13.87	638.4	87.57
(SP70550-01x7042-0)	x SP6922-0	4513.4	240.88	18.76	13.96	718.5	86.28
Overall Mean		5005.5	245.38	20.44	14.01	712.0	87.56
LSD (5%)		326.1649	9.1513	1.3038	.4146	75.5383	1.0497
Coefficient of Variation		5.6184	3.2157	5.4993	2.5514	9.1483	1.0337

Test 38502 - (continued) East Grand Forks, Minnesota, 1973

Equalized Random Block
6 replications, 2-row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.

HYBRID CMS	"O"	Pollen	Raffinose (Percent on Beet)	Kestose (Percent on Beet)	Sodium (Parts per million)	Potassium (Parts per million)	Amino Nitrogen (Parts per million)	Impurity Index Carrouthers Formula
American #2 Hybrid B			.08	.04	517.2	1648.1	580.8	799.9
U&I(100363x12163)	x	70P23	.08	.03	495.6	1678.9	630.4	838.3
SP6926-01	x	70P21	.07	.03	483.3	1801.1	538.2	815.3
U&I(11866x12166)	x	SP6822-0	.07	.03	547.2	1714.4	602.8	863.8
FC506ms	x	70P23	.07	.02	445.6	1593.3	606.5	775.0
SP71550-01	x	70P23	.06	.03	317.8	1492.2	723.3	766.5
U&I(1861x2161)	x	70P23	.06	.03	447.2	1615.0	658.6	817.2
(100363x12163)	x	70P21	.06	.03	457.5	1638.3	754.2	881.3
(12166x12163)	x	70P23	.07	.03	498.3	1606.4	728.9	873.8
SP69550-01	x	SP6322-0	.07	.03	375.6	1692.8	596.4	776.6
SP69557-01	x	SP6922-0	.07	.03	369.4	1793.3	632.6	828.5
(SP70550-01x7042-0)	x	SP6922-0	.07	.03	435.8	1886.4	724.6	914.7
Overall Mean			.07	.03	449.2	1680.0	648.1	829.3
LSD (5%)			.0147	.0085	70.1724	155.6448	65.5874	69.9800
Coefficient of Variation			18.1182	25.5113	13.4692	7.9882	8.7259	7.2763

Test 24215 - Rocky Ford, Colorado, 1972

Randomized Block
8 replications, 2 row plots
25 ft long, 22 in. between rows

American Crystal Sugar Co.
Planted April 25, 1972
Harvested Oct. 25, 1972

HYBRID			Recoverable Sugar per Acre	Recoverable Sugar per Ton	Beets Acre	Sucrose	Known Sugar Loss/Acre	Sugar Recovery
CMS	"O"	Pollen	Pounds	Pounds	Tons	Percent	Pounds	Percent
American #2 Hybrid B			7583.2	225.26	33.79	12.49	828.8	90.20
67-74HO		x Klein 74832	8320.1	236.00	35.40	13.28	1054.7	88.83
68-314ms	x 68-84	x 74832	8192.1	229.52	35.69	12.89	1010.5	89.01
SP67550-01		x Klein 74832	7562.3	280.48	26.96	15.15	602.7	92.53
SP691203H02			6814.8	235.24	28.96	12.93	676.7	90.98
SP68608-1		x SP6822-0	6133.0	226.81	26.96	12.52	638.3	90.51
SP68661-1		x SP6822-0	5821.0	228.92	25.39	12.68	624.8	90.26
SP68599-02		x SP6822-0	5772.4	261.18	22.09	14.04	476.1	92.31
SP6423-01	x SP67550-0	x SP6822-0	6182.9	247.66	24.98	13.51	560.3	91.66
11866	x 12166	x 70P21	8327.1	230.41	36.23	12.66	828.7	90.98
100363	x 12163	x 70P23	7815.2	225.27	34.79	12.52	879.5	89.88
68-314		x SP67599-0	6140.2	252.77	24.33	13.87	599.3	91.14
Overall Mean			7055.4	239.96	29.63	13.21	731.7	90.69
LSD (5%)			808.8387	11.4416	3.4535	.5377	115.6278	1.0166
Coefficient of Variation			11.3253	4.7103	11.5139	4.0236	15.6110	1.1074

Test 24215 - (continued) Rocky Ford, Colorado, 1972

Randomized Block
8 replications, 2 row plots
25 ft long, 22 in. between rows

American Crystal Sugar Co.
Planted April 25, 1972
Harvested Oct. 25, 1972

HYBRID			Raffinose	Kestose	Sodium	Potassium	Amino Nitrogen	Impurity Index Carrouthers Formula
CMS	"O"	Pollen	Percent on Beet		Parts per million			
American #2 Hybrid B			.12	.01	1195.3	924.7	184.7	653.7
67-74HO		x Klein 74832	.13	.01	1251.3	1294.7	250.2	744.8
68-314ms	x 68-84	x 74832	.12	.01	1346.7	1245.0	179.2	732.4
SP67550-01		x Klein 74832	.12	.01	682.7	1240.7	226.3	497.8
SP691203H02			.15	.02	1023.3	1023.3	180.5	601.5
SP68608-1		x SP6822-0	.16	.01	1021.7	1056.7	186.6	632.9
SP68661-1		x SP6822-0	.13	.01	968.0	987.3	263.4	649.1
SP68599-02		x SP6822-0	.15	.02	773.3	1009.4	222.1	515.0
SP6423-01	x SP67550-0	x SP6822-0	.14	.01	900.8	931.9	222.5	556.0
11866	x 12166	x 70P21	.14	.01	1130.0	846.7	169.4	601.5
100363	x 12163	x 70P23	.13	.01	1250.0	955.0	183.0	674.6
68-314		x SP67599-0	.15	.01	1053.3	985.0	226.4	590.4
Overall Mean			.14	.01	1049.7	1041.7	207.9	620.8
LSD (5%)			.0172	.0069	161.6687	128.8448	46.9258	66.9164
Coefficient of Variation			12.3557	53.8103	15.2274	12.2291	22.3207	10.6571

Test 24222 - Rocky Ford, Colorado, 1972

Randomized Block
8 replications, 2 row plots
25 ft long, 22 in. between rows

American Crystal Sugar Co.
Planted April 25, 1972
Harvested Oct. 25, 1972

HYBRID			Recoverable Sugar per Acre	Recoverable Sugar per Ton	Beets Acre	Sucrose	Known Sugar Loss/Acre	Sugar Recovery
CMS	"O"	Pollen	Pounds	Pounds	Tons	Percent	Pounds	Percent
American #2 Hybrid B			7001.5	215.25	32.81	12.53	1169.4	85.84
68-313		x FC903	6526.9	201.56	32.76	12.00	1240.3	84.28
SP68735-1		x 6822-0	5313.3	205.16	25.93	12.17	995.2	84.29
SP68744-1		x 6822-0	5538.9	226.25	24.52	13.19	923.6	85.78
SP67550-01		x 6822-0	6655.0	241.75	27.41	13.76	915.3	87.77
68-83HO	x FC504	x Klein 74881	6836.9	223.06	30.53	13.07	1175.6	85.33
68-81HO	x FC504	x Klein 74881	5632.2	214.80	26.23	12.86	1110.6	83.47
68-85HO	x 68-82	x Klein 74881	5976.6	220.19	27.13	12.98	1066.8	84.82
68-82HO	x 68-81	x Klein 74881	6645.0	228.18	29.17	13.37	1143.0	85.30
BJ-3		x 54-604	6855.0	226.93	30.30	13.25	1150.8	85.60
SL129ms	x 68-84	x 65-424	8161.2	234.39	34.84	13.56	1282.2	86.41
67-75HO		x Klein 74832	6786.7	233.68	29.05	13.50	1050.8	86.54
Overall Mean			6494.1	222.60	29.22	13.02	1102.0	85.45
LSD (5%)			1140.1321	12.9836	5.139	.6419	218.9034	1.3634
Coefficient of Variation			17.6266	5.8560	17.658	4.9509	19.9440	1.6019

Test 24222 - (continued) Rocky Ford, Colorado, 1972

Randomized Block
8 replications, 2 row plots
25 ft long, 22 in. between rows

American Crystal Sugar Co.
Planted April 25, 1972
Harvested Oct. 25, 1972

HYBRID			Raffinose	Kestose	Sodium	Potassium	Amino Nitrogen	Impurity Index Carrouthers
CMS	"O"	Pollen	Percent on Beet		Parts per million			Formula
American #2 Hybrid B			.08	.03	1185.8	1216.7	511.2	944.0
68-313		x FC903	.06	.02	944.4	1478.5	599.6	1039.1
SP68735-1		x SP6822-0	.08	.02	1285.4	1421.2	519.3	1047.2
SP68744-1		x SP6822-0	.09	.02	1235.4	1349.2	533.5	947.9
SP67550-01		x 6822-0	.08	.02	920.8	1277.5	524.7	815.6
68-83HO	x FC504	x Klein 74881	.07	.02	1222.5	1461.2	536.1	978.0
68-81HO	x FC504	x Klein 74881	.08	.02	1175.0	1457.9	707.2	1101.7
68-85HO	x 68-82	x Klein 74881	.08	.02	1272.9	1469.2	555.7	1012.2
68-82HO	x 68-81	x Klein 74881	.08	.02	1019.6	1542.3	629.8	979.7
BJ-3		x 54-604	.07	.02	1119.6	1313.7	606.5	959.9
SL129ms	x 68-84	x 65-424	.08	.02	900.0	1516.2	594.0	905.9
67-75HO		x Klein 74832	.06	.02	1136.7	1361.5	523.5	897.2
Overall Mean			.07	.02	1118.2	1405.4	570.1	969.1
LSD (5%)			.0131	.0098	145.4000	198.7029	80.6586	90.7455
Coefficient of Variation			17.5135	46.7113	13.0580	14.1977	14.2078	9.4038

Test 28215 - East Grand Forks, Minnesota, 1972

Randomized Block
4 replications, 2 row plots
25 ft long, 22 in. between rows

American Crystal Sugar Co.
Planted May 26, 1972
Harvested Sept. 28, 1972

HYBRID			Beets Acre Tons	Sucrose Percent	GROSS sugar per Acre Pounds
CMS	"O"	Pollen			
American #2 Hybrid B			16.78	14.24	4760.3
67-74HO		x Klein 74832	16.47	14.59	4795.5
68-314ms	x 68-84	x Klein 74832	16.98	14.62	4966.6
SP67550-01		x Klein 74832	14.34	15.66	4493.5
SP691203H02			14.04	13.84	3889.0
SP68608-1		x SP6822-0	15.15	13.87	4192.0
SP68661-1		x SP6822-0	14.65	14.07	4131.5
SP68599-02		x SP6822-0	11.58	14.65	3416.1
SP6423-01	x SP67550-0	x SP6822-0	15.27	14.62	4465.3
11866	x 12166	x 70P21	16.01	15.27	4884.5
100363	x 12163	x 70P23	16.28	14.80	4816.5
68-314		x SP67599-0	14.49	14.25	4131.0
Overall Mean			15.17	14.54	4411.8
LSD (5%)			2.2818	.8202	669.9348
Coefficient of Variation			10.4539	3.9206	10.5547

Test 28236 - East Grand Forks, Minnesota, 1972

Randomized Block
4 replications, 2 row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.
Planted May 26, 1972
Harvested Sept. 28, 1972

HYBRID				Recoverable Sugar per Acre	Recoverable Sugar per Ton	Beets Acre	Sucrose	Known Sugar Loss/Acre	Sugar Recovery
CMS	"O"		Pollen	Pounds	Pounds	Tons	Percent	Pounds	Percent
American #2 Hybrid B				5022.5	288.34	17.34	15.80	480.8	91.19
SP68625-1		x	SP6822-0	5104.3	280.38	18.20	15.49	545.4	90.35
SP68641-1		x	SP6822-0	4836.8	273.53	17.67	15.31	576.9	89.31
SP6426-01	x SP67550-0	x	SP6822-0	4460.7	283.97	15.70	15.61	443.0	90.94
SP68522-01	x "	x	"	4049.1	290.75	13.93	15.95	393.8	91.14
SP6423-01	x "	x	"	4787.6	286.43	16.70	15.70	461.2	91.21
SP67505-01	x SP67555-0	x	"	4518.0	278.68	16.22	15.62	548.7	89.17
SP68519-01	x "	x	"	4443.4	299.26	14.95	16.36	419.5	91.42
SP67547-01	x "	x	"	4646.6	277.46	16.73	15.47	535.0	89.63
SP6721-01	x "	x	"	4079.6	274.60	14.85	15.26	453.0	89.96
SP6926-01		x	70P21	4718.2	269.57	17.55	14.85	481.8	90.74
"	x	x	70P23	4872.0	277.78	17.59	15.27	487.9	90.92
Overall Mean				4628.2	281.73	16.45	15.56	485.6	90.50
LSD (5%)				714.8839	13.9308	2.4643	.6254	92.8091	1.1779
Coefficient of Variation				10.7235	3.4329	10.3983	2.7936	13.2691	.9036

Test 28236 - (continued) East Grand Forks, Minnesota, 1972

Randomized Block
4 replications, 2 row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.
Planted May 26, 1972
Harvested Sept. 28, 1972

HYBRID CMS	"O"	Pollen	Raffinose	Kestose	Sodium	Potassium	Amino Nitrogen	Impurity Index Carrouthers Formula
			Percent on Beet		Parts per million			
American #2 Hybrid B			.10	.03	522.5	1595.0	378.4	587.1
SP68625-1		x SP6822-0	.11	.03	536.2	1838.7	362.9	628.6
SP68641-1		x SP6822-0	.10	.03	646.2	2297.5	322.2	712.9
SP6426-01	x SP67550-0	x SP6822-0	.10	.03	420.0	1775.0	390.9	604.1
SP68522-01	x "	x "	.10	.03	488.7	1550.0	425.6	590.5
SP6423-01	x "	x "	.10	.03	438.7	1715.0	374.2	585.7
SP67505-01	x SP67555-0	x "	.10	.03	556.3	1961.2	491.4	722.2
SP68519-01	x "	x "	.10	.03	390.0	1613.7	436.6	571.9
SP67547-01	x "	x "	.10	.02	561.2	1692.5	498.1	691.4
SP6721-01	x "	x "	.10	.03	595.0	1688.7	434.9	669.5
SP6926-01		x 70P21	.09	.02	560.0	1563.7	363.7	617.2
"		x 70P23	.10	.03	542.5	1526.2	391.9	605.0
Overall Mean			.10	.03	521.5	1734.8	405.9	632.2
LSD (5%)			.0250	.0134	115.9805	347.2249	78.5079	76.1804
Coefficient of Variation			17.3504	32.2104	15.4596	13.9122	13.4437	8.3760

Test 28237 - East Grand Forks, Minnesota, 1972

Randomized Block
4 replications, 2 row plots
25 ft long, 22 in. between rows

American Crystal Sugar Co.
Planted May 26, 1972
Harvested Sept. 28, 1972

CMS	HYBRID "O"	Pollen	Recoverable Sugar per Acre Pounds	Recoverable Sugar per Ton Pounds	Beets Acre Tons	Sucrose Percent	Known Sugar Loss/Acre Pounds	Sugar Recovery Percent
American #2 Hybrid B			4992.5	286.65	17.42	15.77	506.1	90.85
SP6926-01		x SP6322-0	4696.3	279.10	17.03	15.41	497.4	90.49
11866	x 12166	x 70P23	5620.5	300.04	18.74	16.34	500.0	91.82
SP68555-01		x SP6322-0	4611.6	290.36	15.85	16.01	474.5	90.66
100363	x 12163	x 65-4116	4400.6	297.27	14.82	16.25	415.9	91.46
1861	x 1261	x 66-4T9	4807.0	285.00	16.87	15.79	520.5	90.26
BJ-2		x 66-4T9	4995.5	289.61	17.29	15.95	507.4	90.79
BJ-3		x 66-4T9	4331.2	291.67	14.87	16.02	429.4	90.99
68-313ms	x 63-6	x 02 Clone	5307.1	290.51	18.26	15.92	511.6	91.21
1861	x 1261	x 02 Clone	5061.1	304.03	16.56	16.57	450.8	91.69
63(5HOx6)		x 02 Clone	4632.9	293.08	15.79	16.07	449.1	91.15
BJ-3		x 54-604	5197.9	289.46	17.95	16.11	579.3	89.84
Overall Mean			4887.8	291.40	16.79	16.02	486.8	90.94
LSD (5%)			795.1069	15.0228	2.8676	.6598	110.2960	1.3112
Coefficient of Variation			11.3068	3.5834	11.8735	2.8630	15.7477	1.0022

Test 28237 - (continued) East Grand Forks, Minnesota, 1972

Randomized Block
4 replications, 2 row plots
25 ft long, 22 in. between rows

American Crystal Sugar Co.
Planted May 26, 1972
Harvested Sept. 28, 1972

HYBRID			Raffinose	Kestose	Sodium	Potassium	Amino Nitrogen	Impurity Index Carrouthers Formula
CMS	"O"	Pollen	Percent on Beet		Parts per million			
American #2 Hybrid B			.12	.04	522.5	1731.2	384.4	609.7
SP6926-01		x SP6322-0	.10	.03	540.0	1930.0	333.5	633.8
11866	x 12166	x 70P23	.12	.04	453.7	1600.0	368.5	545.0
SP68555-01		x SP6322-0	.12	.04	440.0	1885.0	412.4	622.4
100363	x 12163	x 65-4T16	.10	.04	445.0	1811.2	350.9	569.1
1861	x 1261	x 66-4T9	.10	.03	472.5	1811.2	452.1	649.6
BJ-2		x 66-4T9	.11	.04	510.0	1905.0	361.0	614.2
BJ-3		x 66-4T9	.09	.03	425.0	1952.5	360.1	600.5
68-313ms	x 63-6	x 02 Clone	.10	.04	532.5	1793.7	331.3	585.9
1861	x 1261	x 02 Clone	.09	.03	487.5	1570.0	391.9	553.9
63(5H0x6)		x 02 Clone	.09	.03	537.5	1407.5	452.7	590.1
BJ-3		x 54-604	.10	.03	611.2	1877.5	455.4	677.4
Overall Mean			.10	.04	498.1	1772.9	387.8	604.3
LSD (5%)			.0226	.0168	90.2881	319.2724	77.5379	87.4132
Coefficient of Variation			15.1967	32.4224	12.5987	12.5171	13.8960	10.0546

Test 28301 East Grand Forks, Minnesota, 1972

Equalized Random Block
6 replications, 2 row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.
Planted May 26, 1972
Harvested Sept. 28, 1972

HYBRID			Recoverable Sugar per Acre	Recoverable Sugar per Ton	Beets Acre	Sucrose	Known Sugar Loss/Acre	Sugar Recovery
CMS	"O"	Pollen	Pounds	Pounds	Tons	Percent	Pounds	Percent
American #2 Hybrid B			4438.9	257.02	17.27	14.70	636.5	87.38
569H3	x	65-202B	4528.8	285.67	15.88	16.05	563.9	88.90
FC506	x	FC901	4526.2	279.53	16.19	15.63	534.9	89.38
FC506	x	FC903	5168.6	275.17	18.80	15.59	686.5	88.21
FC506	x	66-405B	4167.5	267.18	15.59	15.12	545.5	88.32
1861	x	02 Clone	4163.8	280.61	14.82	15.66	480.4	89.58
1861	x	SP6528-01	4371.4	277.94	15.72	15.44	482.2	90.01
1861	x	SP6423-01	5011.7	277.08	18.08	15.62	635.8	88.68
FC(502x504)	x	65-202B	4219.6	284.03	14.80	15.95	514.3	88.97
FC(502x504)	x	64-208-0	4228.8	269.56	15.70	15.31	574.6	88.02
SL(129x133)ms	x	FC702	4459.6	272.73	16.33	15.52	612.2	87.83
SL(129x133)ms	x	02 Clone	4872.0	280.64	17.36	15.87	635.6	88.43
Overall Mean			4513.1	275.60	16.38	15.54	575.2	88.64
LSD (5%)			301.3158	11.1086	1.1915	.4775	66.9319	1.0135
Coefficient of Variation			5.7568	3.4755	6.2730	2.6496	10.0332	.9858

Test 28301 - (continued) East Grand Forks, Minnesota, 1972

Equalized Random Block
6 replications, 2 row plots
35 ft long, 22 in. between rows

American Crystal Sugar Co.
Planted May 26, 1972
Harvested Sept. 28, 1972

HYBRID			Raffinose	Kestose	Sodium	Potassium	Amino Nitrogen	Impurity Index Carrouthers Formula
CMS	"O"	Pollen	Percent on Beet		Parts per million			
American #2 Hybrid B			.10	.02	862.1	1586.7	593.8	841.3
569H3	x	65-202B	.09	.04	646.8	1766.4	569.4	740.0
FC506	x	FC901	.08	.03	682.1	1516.4	541.0	707.8
FC506	x	FC903	.08	.03	634.6	1674.6	642.9	785.7
FC506	x	66-405B	.10	.03	780.8	1589.6	559.7	778.5
1861	x	02 Clone	.10	.03	658.6	1453.2	547.9	694.6
1861	x	SP6528-01	.11	.05	692.1	1455.4	467.8	666.1
1861	x	SP6423-01	.10	.03	654.6	1527.9	626.7	754.4
FC(502x504)	x	65-202B	.08	.03	722.9	1753.3	530.1	735.2
FC(502x504)	x	64-208-0	.09	.05	731.7	1761.7	581.7	798.5
SL(129x133)ms	x	FC702	.09	.03	754.2	1587.6	657.3	811.2
SL(129x133)ms	x	02 Clone	.09	.03	703.1	1542.6	658.0	771.5
Overall Mean			.09	.03	710.3	1601.3	581.4	757.1
LSD (5%)			.0143	.0165	79.9445	111.2950	54.3194	67.5642
Coefficient of Variation			13.2059	42.6025	9.7047	5.9929	8.0564	7.6950

SUGARBEET DISEASE INVESTIGATIONS IN 1973

C. L. Schneider

I. Blackroot disease (Aphanomyces cochlioides).

a. Aphanomyces oospore inoculum - An improved method of producing oospore inoculum for initiation of experimental infection of sugarbeet seedlings was developed. The spores are produced in about 30 days in mycelial mats grown in flasks of .5% homogenized oatmeal broth adjusted to pH 6.5 and incubated in darkness. The mats are subsequently macerated in a blender with water and oospore concentration is determined with a spore-counting chamber. The spore suspension is then diluted according to the spore concentration desired - usually ca 2.5×10^3 spores/ml - and mixed with vermiculite in the ratio of 1:2.5 parts V:V respectively. When dry, the inoculum is ready to use. The optimum level of inoculum needed to initiate infection when applied with the seed at planting usually equals $1\text{-}2 \times 10^4$ oospores/4-in. pot containing 400 ml of soil. The inoculum may be placed above, below, or at the same level as the seed. Black root symptoms generally appear within 30 days after planting.

Oospore inoculum has remained viable for over 30 months. Viability was retained better at -4° and at 5° C than at room temperature (19-22° C).

b. Oospore germination in vitro - Aphanomyces cochlioides oospores in .5% oatmeal agar cultures were observed to germinate after the cultures had been transferred to .3% peptone broth for about 4 days then re-transferred to plates with a shallow layer of well water or of Yang and Schoulties replacement water solution[1/], consisting per liter :1.5×10^{-3}M $CaCl_2$; 0.2×10^{-3}M $MgSO_4$ and 1.5×10^{-3}M KCl. Among 1700 oospores examined microscopically, 1.9% appeared to germinate. Some of the germ hyphae functioned as zoosporangia, producing numerous motile zoospores. It is highly probable, therefore, that germinating A. cochlioides oospores may initiate infection of susceptible hosts, in part at least, by production of motile swarm spores that subsequently germinate and penetrate the root tissue.

c. Greenhouse tests of black root resistance (G. J. Hogaboam and R. C. Zielke, cooperators). Entries were grown in pots infested with A. cochlioides oospores. Among 275 eastern breeding lines, 40.4% were rated as more resistant than US H20 check variety and 0.4% were rated as more susceptible. Among 121 experimental hybrids tested, 2.5% were rated as more resistant and 4.1% were rated as more susceptible than the check variety.

1/ Yang and Schoulties, 1972. A simple, chemically defined medium for the growth of Aphanomyces euteiches and some other Oomycetes, Mycopathol. et Mycol. Appl. 46:5-15.

Plants were selected among the survivors of greenhouse screening tests as sources of black root resistance in the breeding program.

d. Effect of black root disease on physiology of the plant - (G. Safir, cooperator). Preliminary growth chamber studies were conducted in regard to the potential use of remote-sensing techniques in assessment of root disease incidence and intensity. Degree of root rot of young sugarbeet plants affected growth rate, transpiration rate and diffusive resistance of leaves 9 days after plants were inoculated with A. cochlioides zoospores. Significant differences in diffusive resistance between a black root-resistant and black root-susceptible variety corresponded closely with their difference in black root reaction.

II. Rhizoctonia Crown Rot (Rhizoctonia solani).

a. Pathogenic capabilities of R. solani crown rot isolates - Seedlings of 11 Great Lakes area crop species were inoculated with R. solani crown rot isolates in the greenhouse. The number of isolates tested on each host ranged from 16 to 36. The reactions of each test species were: highly susceptible (sugarbeet, navy bean); moderately susceptible (cabbage, corn, soybean, sunflower); lightly susceptible (turnip, cucumber, sweet clover, pepper, and tomato). Wide differences in virulence among isolates were noted on tomato. None of the Rhizoctonia isolates collected from over 100 sources in Michigan and northern Ohio in 1971-72 proved capable of overcoming the resistance of breeding line FC701 in greenhouse inoculations of young plants.

b. The effect of crop rotation on crown rot - A cropping systems and sequence study that includes sugarbeet was recently initiated by the Michigan State University Crop and Soil Sciences Department at the Saginaw Valley Bean and Beet Research Farm. In Sept. 1973, sugarbeet plots in the experiment were surveyed for occurrence of diseases, including crown rot. In plots following corn, incidence of crown rot was significantly lower than in plots following beans or oats.

c. Tests of fungicides to control crown rot-(H. S. Potter, cooperator). Two tests were conducted in plots infested with R. solani dried sorghum inoculum. In one test, soil treatments were applied as granules before planting (1 treatment), or on the soil surface after planting (7 treatments). In an adjoining test, treatments were sprayed along the rows and into the crowns on 3 dates at 14-day intervals, (19 treatments). In both experiments disease development was unusually severe, with 11.9 percent of plants in the untreated control plots surviving. Although none of the fungicide treatments effectively controlled the disease, crown rot severity tended to be less with the following treatments, which had appeared promising in previous, less-rigorous, tests: PCNB 2 lb active /acre (22.3% survival); chlorothalonil 1.5 lb + sticker-spreader (23.1%); benomyl 4 oz (22.3%); carboxin 3 lb (21.7%). Among the soil treatments, chlorothalonil 8 lb active/acre resulted in highest stand survival (25.4%) compared with untreated control (12.2%).

c. Rhizoctonia nursery - Half of the entries tested for resistance in the Rhizoctonia nursery were exposed to dry sorghum grain inoculum side-dressed at the rate of 3.5 ml/ft of row on 26 June. The other entries were inoculated in the crowns with dried barley grain inoculum (3 ml/ft of row) on 21 July and on 17 August. Degree and intensity of disease were determined at harvest and expressed as a single numerical rating ranging from 0 (no disease) to 100 (all plants dead). Among the entries inoculated by the side-dress method, average disease ratings ranged from 49 to 99 (av. rating of FC701/5 check plots = 74). Among the entries inoculated in the crowns, average ratings ranged from 14 to 80 (FC701/5 =12). From entries with disease ratings significantly below those of the non-resistant commercial variety, roots were selected as sources of resistance in the breeding program.

III. Cercospora Leaf Blight or Cercosporiosis (Cercospora beticola).

a. Fungicide screening test - (H. S. Potter, cooperator). A test of 19 fungicide-spray adjuvant combinations was conducted in a field planting of variety US H20 artificially infested with dried sugarbeet leaf inoculum. Treatments were applied at 60 gal/acre with a CO_2-activated hand-operated sprayer. Disease development in untreated control plots was of moderate intensity, rating 4.5 on an intensity scale from 0 (no symptoms) to 9 (complete defoliation). The most effective treatments applied at a 21-day schedule included the systemic fungicides: benlate; methyl [1-[[(5 cyanopentyl)amino]carbonyl]-1H-benzimidazol-2-yl]; thiabendazole, and thiophanate methyl. Effective control with benomyl was obtained with an increase from 2 to 4 oz (active)/acre. The effectiveness of a protective copper fungicide was significantly improved by the addition of sulfur at 3 lb/acre.

b. Studies on aerial application of fungicides - (H. S. Potter; J. Widner, Northern Ohio Sugar Co.; Luther Gibbs, aerial applicator; cooperators). Tests were conducted at 4 locations in Ida, Michigan and Old Fort, Ohio areas. Average disease severity ratings in non-treated plots ranged from 4.9 to 6.7. Two sprays of each treatment were applied at a 21-day interval. There was a total of 13 treatments in the 4 tests. In the Ida tests, three copper fungicides and maneb each significantly reduced disease severity and resulted in significantly increased root and gross sugar yields. In the Old Fort area benomyl and triphenyltin hydroxide applications were likewise effective in reducing disease intensity and increasing yields. The triphenyltin hydroxide treatment also resulted in increased sucrose percentage. The addition of a foaming agent and a thickening agent did not alter the effectiveness of triphenyltin and benomyl fungicides but noticeably reduced lateral drift.

c. Cercospora nursery - There were 204 entries tested in the nursery artificially infested with C. beticola inoculum. The average disease rating of check varieties UI(11866 x 12166) x SP6822-0 and UI(100363 x 12163) x SP6822-0 = 4.2. Among 132 breeding lines tested, 126 had disease ratings significantly lower than the average of the two check varieties and 18 had ratings significantly lower than the general mean rating of all entries. Plants were selected as sources of resistance from among the entries rated as superior.

Papers Published or Submitted in 1973

1. Potter, H. S., C. L. Schneider, P. B. Brimhall and F. B. Russell. 1972. Results of aerial spray tests to control Cercospora leaf spot disease of sugarbeet. Fungicide and Nematicide Tests - Results of 1972. 28:102. Amer. Phytopathol. Soc.

   A total of three surface protectant and five systemic type fungicide treatments were tested at Ida, Michigan, Ottawa and Green Springs, Ohio. At all locations, two applications of each treatment effectively controlled the disease. At Ottawa, one application of benomyl and TBZ provided effective control, but at Ida, one application was less effective. Benomyl applied at 2 gal/A was as effective as when applied at 5 gal/A.

2. Schneider, C. L., R. L. Sims and H. S. Potter. 1972. Tests with fungicides to control Cercospora leaf spot disease of sugarbeet. Fungicide and Nematicide Tests - Results of 1972. 28:102-103. Amer. Phytopathol. Soc.

   The efficacy of 11 fungicides was tested at various dosages and spray schedules, with and without specified adjuvants. All 21 treatments reduced leaf spot severity significantly below that of the control. The relative effectiveness of the treatment is shown. Foam application of benomyl was as effective as conventional spray application and caused no apparent phytotoxicity.

3. Potter, H. S. and C. L. Schneider. 1973. Aerial spraying to control sugarbeet leaf spot disease. Agric. Aviation 15:10-15.

   The effectiveness of aerial spraying with surface protectant and with systemic fungicides to control leaf blight in southern Michigan and northern Ohio was demonstrated in experiments conducted in growers' fields.

4. Schneider, C. L. 1973. Control of Rhizoctonia root rot of sugarbeet. Proc. 17th Reg. Meet. of Am. Soc. of Sugar Beet Technol., Eastern United States and Eastern Canada. p. 60-64.

   Three main types of control measures proposed to combat the disease are described, including: 1) the modification of cultural practices, 2) the development of resistant varieties, and 3) the use of fungicides. A discussion of the efficacy and feasibility of each follows.

5. Schneider, C. L. and D. L. Yoder. Development of a methodology for the production of Aphanomyces cochlioides oospores in vitro. Submitted to J. Am. Soc. Sugar Beet Technol.

   Media for in vitro production of oospores are described. Oospore production at initial pH of 6.30-6.75 was significantly greater than at lower and higher pH. Light inhibited oospore production. Oospores produced in vitro germinated and initiated infection of sugarbeet seedlings.

6. Schneider, C. L. and H. S. Potter. Tests with soil treatments and crown sprays to control Rhizoctonia crown and root rot of sugarbeet. Submitted to J. Am. Soc. Sugar Beet Technol.

Pre-plant applications of PCNB (8 and 16 lb a.i./A) and crown spray applications of chlorothalonil (1.5 lb) PCNB (2 and 4 lb) and TPTH (0.3 lb) significantly reduced incidence and severity of the disease.

PHYSIOLOGICAL INVESTIGATIONS - 1973

F. W. Snyder

Germination and Emergence Studies

I. Sand emergence test: Seeds are placed at a depth of 1½ inches in fine quartz sand (1 to 0.1 mm) at 4% moisture. The emergence count is concluded 12 days after planting in closed containers. Temperature is about 70° F.

The above emergence test is capable of detecting differences in seedling emergence potential of sugarbeet which cannot be detected by the blotter germination test.

The effect of specific environmental factors during seed development and maturation on emergence potential may be evaluated more critically by the sand emergence test than by blotter germination.

We have seedlots which emerge from at least 90% to as low as 10% in the sand emergence test. These will be used in field emergence studies to relate sand emergence to field emergence.

We are attempting to use the emergence test to more precisely determine the point, preferably measured by heat units, at which seeds of commercial hybrids are physiologically mature and will have the highest field emergence. We need clear evidence that genetic factors affect the emergence potential of seedlots. Two seedlots grown by the West Coast Beet Seed Company will be used for this phase of the study.

II. Water absorption test: Weighed samples of air dried fruits (about 1 gram) are immersed in water for four hours. They are then blotted free of excess water and reweighed. The percentage of water absorbed is expressed on the air dried weight.

For fruits harvested at different stages of maturity from individual plants, we have found that the more immature the fruits were, the greater was the fruit moisture; and after being air dried and immersed in H_2O, the more water the fruits absorbed. Thus, with additional research, the water absorption test might indicate degrees of maturity where specific maturity data are lacking. As proposed, the test can provide quantified data within 5 hours.

A number of commercially grown seedlots, having a range in germination percentages which suggested that the seedlots may have been harvested at different stages of maturity, have been used in the water absorption test. Each seedlot had been commercially processed. The water absorption data suggest a number of points: 1) At least three replications should be run for each seedlot, so that statistical data can be used where small differences occur between seedlots. 2) The seedlots

did not process uniformly (cork not uniformly removed, possibly due to different degrees of maturity) and this is reflected in the variation in the quantity of water absorbed. 3) Point 2 suggests that unprocessed fruits should be used in order to properly interpret the water absorption data. 4) The fruits of each female line appeared to have a "characteristic" moisture percentage at the stage that was judged as "mature". 5) If the water absorption test data for the various seedlots are related to either germination or emergence percentages, corrections must be made for the variable numbers of non-viable seeds, particularly if non-viable seeds exceed 2%.

It would be wise policy to set aside ½ to 1 pound of unprocessed seed of each seedlot should it be needed to fully evaluate a germination or emergence problem.

Growth Analysis of Sugarbeet Seedlings

Growth analysis has focused on leaf and root accretion and a growth-partitioning ratio. The growth-partitioning ratio is defined as the Taproot weight divided by the Leaf Blade weight. This quantifies the relationship of the taproot to photosynthetic capacity of the individual plant. At least in theory, a plant with greater leaf accretion and with greater translocation into the taproot (has a larger growth-partitioning ratio for root-growth) will out-yield one with lesser of each of these attributes.

Some of the recent findings are summarized:

1. Analysis of 156 seedlings of Hogaboam's pollinator line 70P23 grown in the growth chamber revealed that only about 4% of the seedlings combine two seedling growth characteristics, a) leaf blade weight greater than one standard deviation above the mean leaf weight, and 2) a growth partitioning ratio greater than one standard deviation above the mean partitioning ratio.

2. Line 70P23 is being used to determine whether the growth-partitioning ratio is subject to selection pressure.

3. G. E. Coe provided genetic material and is collaborating in a comparison of growth of seedlings resulting either from crossing or from selfing. Ninety-three percent of the seedlings resulting from crosses had greater leaf area (or leaf blade weight) and 90% had greater taproot weight than those from selfing. These high percentages confirm the heterotic effect of crossing on leaf and taproot development. In contrast, only about half of the seedlings resulting from crossing had a larger growth-partitioning ratio as compared with selfing. This suggests that the growth-partitioning ratio may be independent of the heterotic effect obtained in crossing.

4. G. E. Coe provided genetic lines and is collaborating in an experiment to determine whether slow-growing seedlings of one line crossed with slow-growing seedlings of another line produce progenies that grow slower than progenies from crossing of the fast-growing seedlings of the same two lines. We are selecting seedlings on the basis of leaf blade weight, since we found that weight is very highly correlated with leaf area.

Physiology of Hybrid Vigor and Inbreeding Depression of Vigor

Presently we are concentrating on producing plantlets, since this project will be seriously handicapped until we have a system of maintaining exact genetic materials. Tissue or cell culture appears to be the only way to produce 50 to 300 genetically identical cloned plants for certain experiments in physiology, in pathology, and in genetics, and, especially, to determine the physiology of hybrid vigor and/or inbreeding depression.

ABSTRACTS OF PAPERS APPROVED FOR PUBLICATION

SNYDER, F. W. Some factors influencing sugarbeet seed germination. Proc. 17th Regional Meeting, Am. Soc. Sugar Beet Technol., E. United States and E. Canada. p. 6-12. 1973

If sugarbeet seeds are too immature, both germination and emergence may be depressed. Emergence through sand from a depth of 1½ inches, as compared with blotter germination, has two advantages: 1) It is more precise than blotter germination in detecting differences in ripeness of seeds harvested at intervals. 2) It can detect seedlots that have difficulty in emerging and that would be undetected by the blotter germination test.

Seedlots absorb progressively more water with increased immaturity. When access to free water is not limited, the seedlot that absorbs the most water is affected more adversely, as measured either by germination or by emergence.

SNYDER, F. W. and N. E. TOLBERT. Effect of CO_2 concentration on glycine and serine formation during photorespiration. Plant Physiology (In press).

Amounts and products of photosynthesis in sugarbeet and tobacco leaves during 10 minutes were measured at different $^{14}CO_2$ concentrations in air. Above 0.03% CO_2, the total amount of ^{14}C incorporated into the glycine and serine pool was about constant. As CO_2 concentration increased the percentage and amount of ^{14}C in sucrose accumulated as an end product. The results suggest that photorespiration at high CO_2 concentration is not inhibited, but that CO_2 loss from photorespiration becomes of less significance.

SNYDER, F. W. and R. C. ZIELKE. Water requirement for maximum germination and emergence of sugarbeet seeds. J. Am. Soc. Sugar Beet Technol. (In press).

Two commercially grown seedlots of a single sugarbeet cultivar, one very sensitive to the quantity of water available during germination and the other relatively insensitive, were used in tests systems to demonstrate a marked differential in germination and emergence which was correlated with the quantity of water available to the seed.

The relatively insensitive seedlot absorbed water more slowly, and after 48 hours of immersion in water, it had absorbed less water than the very sensitive one. Whenever a system contained an excess of free water, germination of the very sensitive seedlot was depressed, often significantly. Whenever water was relatively limited and slowly available, the very sensitive seedlot germinated nearly as high as the less sensitive one.

ZIELKE, R. C. and F. W. SNYDER. Impurities in sugarbeet crown and root. J. Am. Soc. Sugar Beet Technol. (Accepted for publication).

The concentration of impurities in crowns averaged 70% more than in roots, but impurities for the whole beet (weighted average of root plus crown) were only 10 to 20% greater than those for roots.

BREEDING SUGARBEETS RESISTANT TO BLACK ROOT AND LEAF SPOT

G. E. Coe

Research work on sugarbeets at the Agricultural Research Center-West, Beltsville, Md. is directed mainly toward varietal improvement in resistance to Aphanomyces black root and Cercospora leaf spot, important diseases in eastern United States.

Highlights of the work at Beltsville are set forth in this report.

Breeding for Leaf Spot Resistance

A test was conducted in the Beltsville leaf spot nursery in 1973 to determine more accurately how much improvement is being made in breeding stocks in their resistance to leaf spot and in agronomic characteristics. Selections were made in the leaf spot nursery in 1959 only from progenies with most leaf spot resistance. Six generations later (1971) the most resistant progenies were again located in the Beltsville nursery. There was enough remnant seed from 12 of the best progenies in 1959 for a nursery test. Twelve of the best 1971 progenies (descendants from the twelve 1959 progenies) were placed in a replicated test with the 1959 lines in 1973. In order to make the test more uniform, the lines being tested were placed between rows of SP(70550-01 x 7042-0) x 6922-0. That is, the progenies being tested occurred only in rows alternating with rows of SP(70550-01 x 7042-0) x 6922-0. The results are presented in Table 1.

Table 1. Average performance of 1959 progenies compared with 1971 progenies.*

	Yield	Sucrose	Other solubles	Raw juice apparent purity	Leaf** spot reading	Roots per 100'-row
	T/acre	%	%	%		No.
Av. of 1959 progenies	25.63	11.54	2.71	80.98	3.8	118
Av. of 1971 progenies	27.37	12.56	2.65	82.58	2.4	122

* Yield and chemical analysis based on entire root and crown.
** Leaf spot ratings: 0 = no spots; 10 = death of plants.

The obvious improvement is the increase in leaf spot resistance. The apparent improvement in root yield and % sucrose must be discounted because increased leaf spot resistance results in increased yield and % sucrose in the Beltsville leaf spot nursery. The difference in % of other solubles is not significant. The lines should be tested in a nursery free from leaf spot to determine the standing of the other characteristics. Because leaf spot resistance is now at a rather high level, selections for other characteristics should be more effective than they have been in previous years.

Breeding for Globe-Shaped Sugarbeets

The observational plots in 1972 (See page E32 of 1972 Sugarbeet Research Report) indicated that experimental globe-shaped hybrid #4 performed reasonably well in comparison with USH21. Remnant seed of hybrid #4 and USH20 were placed in a replicated test in the Beltsville leaf spot nursery. There were 6 replications, and four 20-foot rows per replication. The center two rows of each plot were harvested and analyzed separately. The results of this test are summarized in Table 2.

Table 2. Results of field test of globe-shaped hybrid #4.

	Av. yield	Av. sucrose	Av. other soluble	Av. raw juice apparent purity	Av. leaf spot reading*	Av. No. roots per 100' of row
	T/acre	%	%	%		No.
Globe hybrid #4	28.71	10.27	3.08	76.09	4.50	153
USH20	24.92	12.59	2.61	82.83	5.00	146

*Leaf spot scale: 0 = no spots; 10 = death of plants.

From the table one can conclude that globe hybrid #4 has enough leaf spot resistance for commercial use. Its root yield also appears to be acceptable. However, the low percentage of sucrose and the low purity render it economically unfeasible. Also, the roots of this hybrid were not all globe-shaped, and even those that were globe-shaped were not as free of branches and root hairs as is desirable.

In our breeding work, the globe-shape characteristic has been found to be rather unstable. Evidence indicates that its inheritance is rather complex. There are also indications that % sucrose and purity improve only a little with each backcross to sugarbeets. Hence, it does not appear that commercially acceptable breeding lines will be forthcoming in the immediate future. On the other hand, the eventual production of globe-shaped sugarbeets must be considered a distinct possibility.

Testing the Effect of Irregular Stand on % Sucrose and % Other Solubles

An experiment was run at the Beltsville nursery to determine what effect irregular stands might have on sugar extraction of two sugarbeet varieties USH20 and USH21. Sixteen 4-row plots 20 feet long were planted of each variety. Seeds were spaced 4 inches apart in the row. At least two skips 30 inches or more long were made in the center two rows of half the plots of each variety. Unfortunately the plots were damaged by a postemergence herbicide and the plots with the most irregular stands were of necessity the ones in which the skips were placed. Therefore, the unthinned plots were chosen arbitrarily and had better stands from the beginning. At harvest time, the plants next to skips were harvested and analyzed separately. Sugar samples of closely spaced beets were arbitrarily taken from those portions of the rows where the beets were thickest. This was done in an attempt to compensate for the thinning caused by the postemergence herbicide. There were then two sugar samples taken from rows with skips ((1) plants next to skips, and (2) closely-spaced plants) and one sugar sample taken from the rows without skips. The results of this experiment are presented in Table 3.

Table 3. Harvest data of irregular plant spacing test.

Variety	Kind of plt.	Av. No. roots/ 100 ft	Av. root yield T/A	Weighted av. % sucrose	Weighted av. % other solubles	Av. % raw juice appt purity	Av. wt./ root in sugar sample
USH20	Skip spaced	91	14.97	14.82	3.35	81.48	1.62
USH20	No skip	144	15.83	15.24	3.30	82.18	1.14
USH21	Skip spaced	82	17.41	15.72	3.59	81.41	2.17
USH21	No skip	109	17.05	16.11	3.47	82.28	1.54

An analysis of variance indicated that USH21 had significantly higher % sucrose and higher % of other solubles than USH20. It also showed that the average root weight of roots in the sugar samples of USH21 was greater than USH20. The analysis also indicated that the average root weight of roots next to skips was greater than the average root weight of roots taken from close spacing. Unfortunately, the test did not show a significant difference in % sucrose or % other solubles of sugar samples of roots next to skips compared with roots taken from close spacing. However, for USH21, the difference in % sucrose for these two categories was very close to the 5% level of significance.

Correlations were run on the variables in this test. There was a significant (5% level) negative correlation between % sucrose and average root weight of roots in the sugar sample. There was also a significant (5% level) positive correlation between % other solubles and average root weight of roots in the sugar sample. Since the analysis of variance showed a significant difference in the average root weight of roots next to skips and closely spaced roots, the correlations are reason to believe that irregular stands might very well result in lower % sucrose and higher content of other solubles ("impurities") and consequently a lower sugar extraction per ton of roots processed. It is hoped that this will be definitely proven when the test is repeated in 1974 with more uniform plant populations.

One other item of interest was gleaned from this experiment. There was a significant difference between replications in the content of other solubles suggesting that some varying factor(s) (such as available nutrients in the soil) is causing a plot-to-plot difference. Such a condition can greatly reduce the effectiveness of field selections for this characteristic.

New Experimental Breeding Lines

Seven new monogerm O-types were located in the indexing progenies in the spring of 1973. These O-types and their male-sterile companion lines were started in the greenhouse and transplanted to the nursery for leaf spot evaluation. Roots were harvested in the fall and seed increases will be made in 1974. Their foliage vigor ratings and leaf spot resistance readings are presented in Table 4.

Table 4. Foliage vigor and leaf spot resistance of new monogerm O-types in the 1973 Beltsville nursery.

Variety designation	Foliage vigor*	Leaf spot rating**	Variety designation	Foliage vigor*	Leaf spot rating**
74564-0 PF	1.75	3.00	74571-0 PF	2.10	2.00
74564-01 MS	2.75	2.50	74571-01 MS	3.50	2.25
74565-0 PF	2.50	3.00	74572-0 PF	2.00	3.00
74565-01 MS	2.50	3.25	74572-01 MS	3.25	2.25
74566-0 PF	1.75	3.25	74574-0 PF	2.50	2.00
74566-01 MS	3.00	3.25	74574-01 MS	4.00	2.00
74570-0 PF	2.00	3.00	SP6922-0 Check	4.00	2.00
74570-01 MS	2.50	3.00			

*Foliage vigor scale: 1 = small foliage; 5 = very large foliage.
**Leaf spot rating scale: 0 = no spots; 10 = death of all leaves.

Some of these new lines appear as resistant to leaf spot as SP6922-0, but combining ability tests must be made to determine their actual value.

Several experimental hybrids derived from the new multigerm pollinator SP72288-0 had good percentage sucrose and low percentage of other solubles again in the 1973 Beltsville nursery. Yields varied depending on which male-sterile monogerm parent was used to produce the hybrid seed. Fifteen different male-sterile monogerm lines were crossed with SP72288-0 in 1973, and seed is available for testing in 1974.